24 SEP 1936

Report of the Haffkine Institute

For the Years 1932-35

BY

LT.-COL. S. S. SOKHEY, I.M.S.

Director, Haffkine Institute

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REPORT OF THE HAFFKINE INSTITUTE FOR THE YEARS 1932-35.

STAFF.

Directors.

Lt.-Col. J. Taylor, D.S.O., M.D. (Glasg.), D.P.H. (Lond.), I.M.S., from 1st January to 25th October 1932.

Lt.-Col. S. S. Sokhey, M.A., M.D. (Edin.), D.T.M. & H. (Lond.), I.M.S., from 26th October 1932 to 22nd July 1935, and from 21st November to 31st December 1935.

Assistant Directors.

Major S. S. Sokhey, M.A., M.D. (Edin.), D.T.M. & H. (Lond.), I.M.S., from 1st January to 25th October 1932.

Dr. S. N. Gore, L.M. & S. (Bom.), from 1st January 1932 to 31st March 1933 (Retired).

Major S. D. S. Greval, B.Sc. (Punj.), M.D., Ch.B., D.P.H., I.M.S., acted as officiating Assistant Director, from 24th November 1932 to 24th April 1933 (Transferred).

Dr. K. S. Mhaskar, M.A., B.Sc., M.D., D.P.H., D.T.M. & H., from 1st April 1933 to 28th November 1934 (Retired).

Dr. P. M. Wagle, M.B. (Bom.), D.Bac. (Manch.), D.P.H. (Lond.), D.T.M. (L'pool), from 1st April 1933 to 31st December 1935. Attached Plague Enquiry till 31st March 1933.

Dr. M. B. Soparkar, B.Hy., M.D. (Bom.), from 1st December 1934 to 11th June 1935 (Transferred to I.R.F.A. Enquiry).

Major R. C. Wats, M.D., D.P.H., D.T.M., I.M.S., from 12th June to 31st December 1935. Acted as Director, from 23rd July to 20th November 1935.

Captain J. R. Dogra, M.D., Ch.B. (Edin.), D.T.M., I.M.S., attached Haffkine Institute, from 16th November to 31st December 1935.

Department of Pharmacology.

Rev. Father J. F. Caius, S.J., F.L.S., M.S.C.I. (Paris), from 1st January 1932 to 31st March 1933 (Retired).

Dr. K. S. Mhaskar, M.A., B.Sc., M.D., D.P.H., D.T.M. & H., from 1st January 1932 to 31st March 1933.

Dr. B. B. Dikshit, M.B., B.S., M.R.C.P., D.P.H., Ph.D., from 3rd October to 31st December 1935.

Department of Biochemistry.

Mr. M. A. Malandkar, M.A., M.Sc.

Mr. S. K. Gokhale, B.A. (Hons.), M.Sc., A.I.I.Sc.

Antirabic Department.

Military Assistant Surgeon Hugh Maurice, I.S.O., I.M.D.

Mr. R. K. Gokhale, S.M.S.

Antiplague Inquiry.

Dr. B. P. B. Naidu, M.D. (Edin.), M.H., D.P.H., D.T.M. (L'pool), till 11th June 1935 (Transferred).

Dr. M. B. Soparkar, B.Hy., M.D. (Bom.), from 12th June to 31st December 1935.

Dr. J. H. Wadia, B.A. (Hons.), B.Sc. (Bom.), Ph.D. (Cantab.), till 31st January 1933 (Retrenched).

Mr. H. S. Bilimoria, M.B., B.S., D.T.M. (L'pool), till 28th February 1933 (Retrenched).

Mr. R. G. Sathe, G.B.V.C., Veterinary Assistant Surgeon.

Mr. E. R. Nagarajan, G.M.V.C., Veterinary Assistant Surgeon.

Inquiry on Maternal Morbidity and Mortality in Child-birth.

Dr. Margaret Balfour, C.B.E., M.D.
Dr. Lucy Wills, M.D.
Mrs. S. K. Talpade, M.B., B.S.
} Inquiry stopped on 31st March 1933.

Tuberculosis Inquiry (stopped in 1934).

Dr. M. B. Soparkar, B.Hy., M.D. (Bom.), till 31st May 1934.

Jemadar C. S. Dhilon, I.M.D., till 30th June 1934.

Voluntary Research Workers.

Dr. R. Row, O.B.E., M.D., D.Sc. (Lond.).

Dr. S. N. Gore, L.M. & S. (Bom.).

Dr. K. S. Mhaskar, M.A., B.Sc., M.D., D.P.H., D.T.M. & H.

Mr. C. R. Mehta, M.Sc. (Bom.).

Medical and Scientific Assistants.

Rao Bahadur G. D. Chitre, L.M. & S., B.M.S. (I)—(Plague Research), from 1st January 1932 to 30th April 1935, and from 1st November to 31st December 1935.

Mr. N. P. Dalal, M.B., B.S. (Bom.), D.P.H., D.T.M. & H. (Eng.), B.M.S. (I)—(General Diagnostic Department), from 1st January 1932 to 30th April 1935 and from 1st November to 31st December 1935; officiated as Plague Research Officer from 1st May to 31st October 1935.

Mr. S. D. Sahasrabudhe, M.B., B.S. (Bom.), acted as Clinical Research Officer, from 1st May to 31st October 1935.

Mr. J. P. Menezes, M.B., B.S., B.M.S. (II).

Mr. T. G. Akula, S.M.S. (Morbid Histology & Malaria). Till 25th October 1932 (Deceased).

Mr. K. H. Bharucha, B.A. (Hons.), B.Sc. (Public Health Chemistry).

Mr. P. H. Kanade, L.C.P.S., S.M.S. (Plague Research), from 8th March 1933.

Chief Technical Assistants.

Mr. J. Petty ... Plague Vaccine—till 31st March 1933.
Mr. A. Petty ... Do. do.
Mr. J. Mallett ... Do. do. —till 31st March 1933.
Mr. T. K. Puduval, B.A.... Do. do. from 1st April 1933.
Mr. A. J. Naidu ... Pathology.

Mr. R. D. Panwalkar, A.M. (Artist & Photographer).

Mr. M. V. Kamat, B.A. (Librarian).

Mr. H. J. Parelkar (Engineer) till 2nd July 1935 (Retired).

Mr. R. L. Savant (do.) from 3rd July 1935.

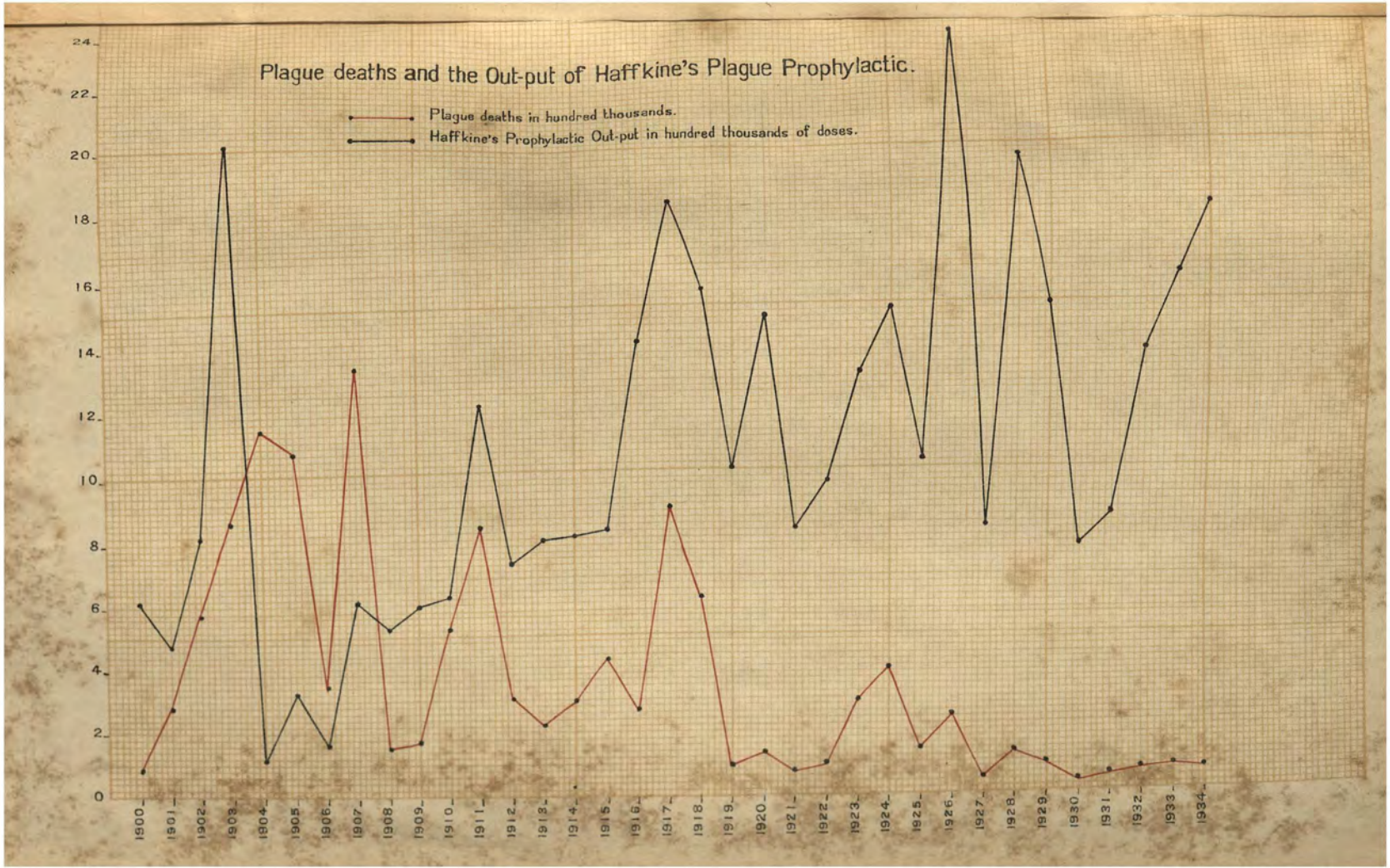
Mr. Shaik Mahomedally (Senior Media Maker) till 1934 (Retired.)

Mr. Ganpat Devji (Senior Media Maker).

Office Staff.

Mr. C. R. Deshpande ... Head Clerk.
Mr. D. N. Mhaskar ... Accountant.
Mr. D. S. Dixit ... Storekeeper.
Mr. S. Y. Nabar ... Packing.

Junior staff, subordinates and menials number 118.


Plague deaths and the Out-put of Haffkine's Plague Prophylactic.
Plague deaths in hundred thousands.
Haffkine's Prophylactic Out-put in hundred thousands of doses.
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GENERAL REVIEW.

The years under review (1932-35) have been a period of considerable stress and strain for the Institute. Early in 1933, the prevailing financial stringency forced the Government to close down one whole department of the Institute (the Department of Pharmacology) and to retrench two senior officers. At about the same time the Central Government withdrew their officer, thus reducing the total strength of the senior staff from six officers to three. This reduction of the staff coincided with a greatly increased demand for Plague Vaccine. In the financial year (April 1933–March 1934) alone, the Institute issued over 2 million doses as against the average yearly demand of 1 million. In addition, in pursuance of the policy of enlarging the usefulness of the Institute to the Presidency, the Institute in spite of the greatly reduced staff, took up the preparation of other vaccines required by the Public Health authorities. Thus in 1934 and 1935 the Institute prepared and issued over 600 thousand doses of Cholera Vaccine, 17 thousand doses of Typhoid Vaccine and 55 thousand doses of Meningococcal Vaccine. This was not all, the Institute gave assistance to the Director of Public Health and the Inspector General of Prisons by sending out workers into the field to investigate the outbreaks of Cerebro-spinal fever. This the Institute could ill-afford to do. Nevertheless, the keenness of the workers and their devotion to duty enabled the Institute to meet this demand as well as the increased demands for its products; and what is of still greater importance, the workers carried out important researches, especially in plague. Some of these plague researches are of very great importance and constitute a great step forward since the days of the Plague Commission.

Plague Department.

(1) *Plague Vaccine.*—The recorded plague deaths are the only indication we have of the incidence of the disease in the country. If the general case mortality has not varied materially during past years, the recorded deaths may be used as an index of incidence, and as such, if plotted against the quantities of the vaccine used yearly, as shown in the accompanying chart, the increasing recognition that this preventive measure is receiving from the health authorities and the public is very evident. The chart also gives some indication that the increasing use of the vaccine is keeping down the incidence of plague in the country. During the four years under review 5·9 million doses were issued, as against an average of 4 million for a similar period before, although there was no marked increase in the incidence of the disease.

Researches in connection with Plague Vaccine.—The lack of a standard method of testing the virulence of plague culture and the

multiplicity of unstandardised experimental conditions employed by different workers had led to contradictory conclusions being put forward. The work of no two workers could be directly compared, nor could the work of the same worker done at different times. No data were available from which one could decide what type of vaccine was best, and what methods should be followed for the preparation of the Plague Vaccine. This state of uncertainty was very disturbing to the Institute, as it was, and still is, the largest producer of Plague Vaccine in the world. About 1929, Sokhey with the assistance of Maurice started fundamental research into these problems. His earlier work was reported in the previous reports, but during the period under review this work has reached a state of completion permitting him to draw definite conclusions. The problems already worked out and described at some length elsewhere in this report (see Part II) have clarified the whole position.

He has worked out an exact method for measuring the virulence of plague cultures, and has found that the laboratory mouse is the animal of choice for plague experiments. Further he has evolved an exact biological method for the standardisation of plague vaccines, with every condition of the experiment fully standardised, so that the method can be employed by any worker anywhere and would still yield directly comparable results. This is the first instance of a successful standardisation of a bacterial antigen and marks a great advance in plague work in recent years.

This advance in knowledge has had immediate practical results. It has enabled the protective power of Haffkine Plague Vaccine to be raised thirty-fold and more. Exact determinations show that the Institute Vaccine is anywhere from 8 to 100 times more potent than any other plague vaccine on the market.

More important still, Sokhey has found that heat killed vaccines do confer a very high degree of protection on mouse, rat and the guinea-pig, and are superior in this respect to live avirulent culture vaccines. He has developed methods to maintain undiminished for long periods the virulence of plague strains and also to render them avirulent without destroying their antigenic power. He was thus in a position to have at one and the same time the same strain of organism in a fully virulent form and in an avirulent form, thus making it possible for the first time to measure the protective power of the same strain in two forms.

Failure of previous workers to protect animals against plague with heat killed vaccines is explained by the fact that they exposed their cultures to unnecessarily high temperatures for unduly long periods of time; for killing their cultures they used temperatures of 60°C to 70°C for one hour to two hours. New methods of measurement have shown that these high temperatures destroy the protective powers of a plague vaccine.

(2) *Antiplague Serum.*—The new knowledge of the characters of *B. pestis* which Sokhey and Maurice gained by their work on

Plague Vaccine has enabled these workers to make fresh efforts at producing a curative serum against plague. They have succeeded in producing a serum which exact laboratory experiments show to be possessed of great potency. With this serum 70 to 80 per cent. of the infected laboratory animals can be saved, while none could be saved with any of the sera on the market. No suitable opportunity has occurred to enable these workers to test the value of their serum in the treatment of human cases, except that a trial is in progress at the time of writing, and that the early results show that while the case mortality in untreated cases is 76 per cent., the case mortality in treated cases has been reduced to 18 per cent. The full significance of these preliminary results can be realised only if compared with the results of previous trials of other sera. Between 1897 and 1912, six different sera (Yersin's, Lustig's, Terni's, Haffkine's, Brazil's and Rowland's) were tried and they failed to make any appreciable reduction in case mortality: the case mortality among the untreated cases was between 70 and 85 per cent. while the case mortality among the treated cases was between 65 and 82 per cent. A serum prepared in this Institute by Naidu, when tested at Poona in 1933, showed a case mortality of 60 per cent. among the treated cases as against a mortality of 85 per cent. among the untreated.

(3) *Plague Phage.*—Furious controversy rages round the question of bacteriophage and its value as a prophylactic and therapeutic agent. Attempts have been made to solve the problem on the basis of statistical data collected in the field, and clinical tests. Both these methods are notoriously difficult. The laboratory animal experiments necessary for the ultimate solution of the problem have so far not been possible. In the case of cholera, typhoid and dysentery infections, the typical diseases cannot be produced in any laboratory animals, and in the case of other infections no standardised experiments have been devised.

As soon as Sokhey and Maurice had worked out an accurately standardised animal experiment in the case of plague they undertook to test the value of plague phage. The results, given in another part of this report, show that plague phage has no action in the body either as a prophylactic or as a curative agent.

(4) *Chemotherapy of Plague.*—A number of mercury and phenol compounds were synthesized in the Institute, and two proprietary drugs, Merthiolate and Salyrgan, were tested by Taylor and Wadia. None of these drugs proved successful.

Later Sokhey tried Trypa-flavin (Bayer) intravenously in experimentally infected mice. The drug is reputed to retain its bactericidal power in blood, but in the case of plague bacteriemia it had no effect.

(5) *Serology of Plague.*—During the work on the production of Antiplague Serum, Sokhey and Maurice had developed exact quantitative methods for measuring the protective and therapeutic value

of the sera produced. These methods, though exact, require a large number of mice and involve a period of about a month for each test. It was, therefore, considered desirable to develop serological methods to see if they could be made to replace the biological test. Furthermore, the exact relationship of the serological tests to biological reactions is not known, and this was considered to be an excellent opportunity of gaining knowledge in this field of bacteriology.

First Greval and Dalal, and later Wats and Wagle have worked on the problem of devising and standardising Agglutination and Complement Fixation techniques applicable to *B. pestis*. The work is proceeding.

(6) *Epidemiology of Plague.*—This department under Rao Bahadur Chitre performs multifarious duties: (*a*) Training is given in plague epidemiology and preventive measures to health personnel of the Presidency as well as of other provinces and Indian States. Over 50 men received training during the period under review. (*b*) In collaboration with the Bombay Municipal authorities it examines between 2,000 and 3,000 rats every morning for signs of plague. This is a very important measure in safeguarding the health of the city of Bombay. Epizootic plague has never been absent from Bombay since the first introduction of the disease in 1896, but the epizootic is now at a very low level, and during the last eighteen months not a single plague infected rat has been found. (*c*) Poona, Bijapur, Belgaum, Sawantwadi and Kolhapur were visited for demonstrating methods of rat and flea destruction with proprietary Calcium Cyanide preparations. (*d*) During 1933 Chitre was deputed to Poona in connection with the Plague epidemic for recommending plague preventive measures. (*e*) A systematic investigation into the relative susceptibility of rats to plague from different areas in India, which had suffered from epidemic plague in varying degrees some time or other during the present pandemic (1897–1935), has been continued. This enquiry has now covered the whole of India except Bengal. The immunity of rats appears to be roughly proportional to the aggregate incidence of plague in the area from which rats are obtained.

(7) *Rat and Flea Destruction.*—Though Plague Vaccine confers a very high degree of immunity it should never be made the sole preventive measure; the extermination of rats and their fleas from human habitation should be energetically conducted, thereby eliminating, altogether, the risk of human infection. So long as we had to depend on trapping and baiting of rats the position was hopeless. But the new proprietary Calcium Cyanide compounds promise to be of great value in this connection.

A method has been worked out for measuring the relative utility, for our purpose, of the different compounds available and experiments are being conducted to determine the best methods for the fumigation of dwellings with these products.

Department of Pharmacology.

This department was started in 1924 and after working for nine years, during which valuable researches on indigenous drugs were carried out, was closed down in 1933 on account of financial stringency.

The need of a Pharmacological Laboratory had long been felt and a Committee appointed by the Government of Bombay reporting in 1920 recommended that such a laboratory be established. The Government of Bombay in General Department Order No. 11028, dated 28th October 1920, accepted their recommendations and ordered that the proposed Pharmacological Laboratory be established in conjunction with the Haffkine Institute (then the Bombay Bacteriological Laboratory). Suitable accommodation was provided by building what is now called the "New Wing" of the Institute. The actual opening of the department was, however, delayed until 1924 by which time over 3 lakhs of rupees had been spent.

The Laboratory made valuable researches on indigenous drugs till 1933, when it was closed down as a measure of retrenchment. This was unfortunate from the point of view of the future development of medicine in this Presidency. A Pharmacological Department in an institute like Haffkine Institute is a necessity. There is a popular movement in the country for the encouragement of indigenous "systems of medicine". It is not fully appreciated that medicine has attained the status of a science and that accurate measurements and planned reasoned experiments are its principal tools today like those of any other science. Just as in the domain of a science like Chemistry there cannot be different systems of Chemistry, similarly there can be no systems of medicine but only the science of medicine. Prescientific systems were based, for lack of adequate knowledge, on doctrines now demonstrated to be false, and all that remains of so-called systems which may have some value, is a number of drugs. Obviously the uncritical use of a set of drugs does not and cannot make a system of medicine, since scientific medicine does not reject the use of any agents for therapeutic purposes, but merely insists that only those agents whose worth has been proved by critical experiments, shall be used. The only point worth considering is that of a critical study of the drugs produced in the country, and the proper place for such a study would be scientific laboratories, and not Unani and Ayurvedic hospitals conducted by men quite innocent of scientific outlook and training in scientific methods. Actively working departments of pharmacology would insure against the wasteful expenditure likely to be involved in the establishment and maintenance of Ayurvedic and Unani institutions.

Such a laboratory will perform still another valuable service to the Presidency. Everyone is aware, and the position was clearly stated by the Drugs Enquiry Committee, that the Indian market is flooded with spurious or very much adulterated drugs, biological

products, and organo-metallic compounds used in the treatment of disease. The results are tragic. A doctor prescribes a potent medicament to save the life of a patient and unwittingly uses a preparation which is not active, with the result that a life is lost. The position can be set right by rigid laws for the control of the sale of drugs. But it is a matter of history that such laws remain a dead letter if not backed by efficient laboratory service. Laws for the control of the sale of drugs, are being considered and when passed, this department, if fully working, would be in a position to do all the control and testing of drugs, etc., necessary for the enforcement of the laws. This function by itself would be a very valuable one, but the department would render a still more valuable service. Strict control of the sale of drugs will for certain give an impetus to the manufacturers of drugs in the Presidency itself. At the start, for some considerable time to come, the firms undertaking such manufacture will not be able to afford expensive scientific departments for final exact testing. This aid the Institute could easily and inexpensively supply. Such testing would be a very valuable help to the industry and to Government agencies and others buying these products.

The reopening of this department on a permanent basis is an urgent necessity, and it is hoped, that Government will find funds for the purpose. In the meantime the Department has temporarily been opened with the generous assistance of the Indian Research Fund Association. The services of a highly trained pharmacologist (Dr. B. B. Dikshit) have been placed at the disposal of the Institute and already valuable research work in connection with Plasmoquin has been produced.

Department of Biochemistry.

This department has proved of great value both to the workers in the Institute for chemical aid in their work as well as to practitioners and hospitals for examination of their clinical material.

The department has been closely associated with research work in connection with preparation of Antiplague Serum, and has continued its work on the determination of normal standards of chemical constituents of blood of adult Indians. The department has now, in addition, taken up vitamin assay work.

Antirabic Department.

The number of cases of dog-bite receiving treatment has shown a progressive increase during the years under review. The mortality rate has varied between 0·12 per cent. and 0·24 per cent. This compares very favourably with the previous years and the results of other institutes in India. A great deal of this improvement is very likely due to complete disinfection of all wounds carried out in this Institute.

The Institute has consistently worked for decentralisation of treatment. It is gratifying to note that there are now 62 centres in the Presidency at which antirabic treatment is given. A scheme is under consideration for opening still more centres in the Presidency.

Tuberculosis Inquiry.

This inquiry financed by the Indian Research Fund Association was brought to a close early in 1933. During 1932-33 Dr. Soparkar and his assistants continued to work on the filterable form of the Tubercle Bacillus. The existence of filterable form of the tubercle bacillus has not received general acceptance and there are outstanding names amongst supporters as well as antagonists of this hypothesis and the subject is still controversial.

Detailed description of work carried out by this Inquiry is given in Part II of this Report.

The Future of the Institute.

The fact cannot be overstressed that true economy lies not in spending less money on the Institute and contracting the spheres of its work—that way, per unit of work done will cost more—but to enlarge the functions of the Institute and thereby not only better safeguard the health of the people of this Presidency, but actually get greater money return. The full development of this Institute perforce must await a thorough overhaul of the system of medical relief and public health work of the Presidency. The present system is antiquated and its reform cannot safely be much longer delayed. The division of the health organisations of the Presidency into Medical (Relief) Department and Public Health Department, working in complete isolation from each other, is not only scientifically indefensible, but is wasteful and inefficient. Modern health needs of the people demand an all-comprehensive department of health, combining the benefits of the maximum of centralisation of control with the utmost of decentralisation of execution. Of a modernised health organisation a much enlarged institute like this would be the very life centre; it would investigate, sift and record data, and give valuable assistance in the formulation and the carrying out of schemes for preserving the health of the people. For any such development the Institute must wait. A great deal, however, can be done straightaway to make the Institute serve the needs of the Presidency better and at a less ultimate cost.

The Institute can, and, should undertake the production of all the vaccines and sera and anti-toxins used in the Presidency. Steps have already been taken in this direction; in addition to the production of Plague and Antirabic Vaccines, the Institute now produces Cholera, Typhoid and Meningococcal Vaccines. But all the sera and anti-toxins are imported, and in the absence of any laws for the control of the sale of these products in India, the

market is flooded with products good and bad. Even if the sale of such products was legally controlled, their cost would still prevent the hospitals from using these products in quantities considered necessary in the treatment of disease. Further, the sera and the anti-toxins, to be fully effective, must be prepared from strains of infective organisms isolated in the country itself. The position can be fully met only by the Institute taking up the preparation of these products, which will then be prepared from local strains, their quality will be fully controlled by exact methods, and the cost of production will be much less. The present Surgeon General with the Government of Bombay—Major-General E. W. C. Bradfield, C.I.E., O.B.E., I.M.S.—has already taken steps in this direction. The case is that the Institute should undertake the preparation of more biological products instead of giving up the manufacture even of those that it is producing at present. Such a suggestion has been voiced seriously, but there is no doubt that it could have arisen only from lack of understanding of the nature of the work which the preparation of biological products involves, and of the nature and purpose of the complex of mental and physical activities which go to make research. Worthwhile vaccines, sera and anti-toxins cannot be made by rigid adherence to set formulæ. Their preparation involves constant investigation, repeated experimentation and exact testing at various stages. The cost of such work if undertaken individually by several private manufacturers would be prohibitive; and as this kind of work would be undertaken by private firms on a profit basis, they are likely to do it indifferently. The State would, therefore, be forced to do all the testing over again to safeguard the interests of the public, with the obvious result of unnecessarily increasing the cost of production. Should all this production be undertaken by a State institution like the Haffkine Institute, not only would all the products be produced and controlled by exact scientific work, but the cost would remain low. It must be clearly understood that research is not a mysterious mystic function which gets vitiated by contact with practical problems. On the contrary, best research arises from the contact of men trained in scientific methods and outlook with every-day problems which cannot await solution but demand instant handling. Of course such men ought not to be over-burdened with routine. They require leisure to pursue problems, but they benefit by actual contact with, and the supervision of, routine work which provides real problems for them.

The next most important step would be the reopening of the Pharmacological Department on a permanent basis, as has been suggested above.

The third urgent need of the Institute is a Mobile Unit for field work. A great deal of investigation in the field can be undertaken by the Institute. This is not possible at present because of lack of staff to go into the field to collect material for investigation. Both the Director of Public Health for the Government of Bombay and the Inspector General of Prisons, Bombay Presidency, have from time to time, appealed for assistance. This assistance can be fully rendered only if the Institute is provided with extra staff.

The cost involved would be small. A proposal on the subject is before the Government. It may be noted that the Madras Government maintains three such units at the King Institute, Guindy.

SOCIAL LIFE AT THE INSTITUTE.

The Critics Club.—This Club has now been in existence since 1924 and during the years under report has proved its great usefulness in promoting social intercourse amongst the members of the Staff. Meetings are predominantly social and informal and are held periodically when papers are read and discussed. The following papers were read by members of the Staff during the years under report:—

(1) The Technique of the Loop, the Plug, the Plate and the Slope. By Dr. Gore.
(2) The Treatment of Tropical Macrocytic Anæmias. By Dr. Wills.
(3) The Technique of the Agglutination and Agglutinin Absorption Test in connection with *B. pestis*. By Major Greval.
(4) Relative Antiplague Immunity of *Rattus rattus* of certain cities and towns of India. By Dr. Chitre.
(5) Filterable Phase of the tubercle bacillus. By Dr. Soparkar.
(6) Plasma Proteins with special reference to Analytical Methods. By Mr. Malandkar.
(7) Destruction of Adult Mosquitoes. By Dr. Gore.
(8) Kindergarten Device for Chemical Anœrobiosis. By Dr. Gore.
(9) The Utility of Protein Reactions in the Routine Bacteriological Examination of Water. By Dr. Gore.
(10) Serology of Typhoid Bacilli. By Dr. Wagle.
(11) Discussion on lines of future work at the Institute. By the Staff.

The Tennis and Cricket Clubs functioned successfully. Several matches were arranged, from time to time, and great keenness in sports was shown by the members of the staff. Sports make a very useful and important adjunct to the life of the Institute. In 1934 it was, therefore, deemed necessary to extend the activities of the two clubs. The Haffkine Institute Sports Club was formed which afforded facilities for games like Hockey and Badminton in addition to Cricket and Tennis.

The Annual Mackie Cup Tournaments have been held regularly and proved a huge success.

From time to time "At Homes" are given by the senior members of the staff to promote social intercourse between the members of the staff and their families.

Great need has been felt, for a long time, for provision of a Recreation Room in the Institute. A room has now been allocated for this purpose and will shortly be opened as soon as it is suitably furnished. This will enable the members of the staff to spend a few spare moments during the day. Light refreshments will be served.

SECTION I.

PLAGUE DEPARTMENT.

A.—HAFFKINE'S PLAGUE PROPHYLACTIC VACCINE.

1. *Manufacture.*—In the years under report a definite, though small, increase in the demand for Plague Vaccine is to be noticed. This increase is to be ascribed entirely to the popularity of the Plague Vaccine, as the total mortality figures, reported in the Public Health Commissioner's Annual Reports, show no increase.

From the opening of the laboratory to the end of 1935, a total of 40,029,315 doses has been issued. The output of the vaccine in quinquennial periods has been as follows :—

Years.	Doses.
1897-1901	2,867,041
1902-1906	3,455,537
1907-1911	3,584,262
1912-1916	4,567,366
1917-1921	6,667,894
1922-1926	7,202,636
1927-1931	5,929,243
1932-1935 (4 years)	5,755,336
	40,029,315

During the years 1932-35 the number of doses of Antiplague Vaccine despatched monthly are detailed below :—

Month.	1931.	1932.	1933.	1934.	1935.
January ...	119,196	128,460	91,758	273,792	134,050
February ...	63,594	130,168	77,640	270,026	203,814
March ...	128,718	98,520	69,144	257,039	120,604
April ...	73,290	89,092	87,504	170,178	71,738
May ...	6,018	34,830	61,636	19,250	38,372
June ...	17,838	20,874	51,330	3,404	816
July ...	17,724	33,710	93,392	48,667	3,861
August ...	71,172	172,512	220,470	113,865	23,794
September ...	90,064	199,222	259,028	176,770	132,067
October ...	90,672	223,230	214,547	175,177	93,296
November ...	65,874	144,210	191,969	122,564	81,110
December ...	138,480	87,150	163,764	163,400	113,522
Total No. of Doses ...	882,640	1,361,978	1,582,182	1,794,132	1,017,044

2. *Distribution.*—The geographical distribution of the vaccine in India and to places outside India during the years 1932 to 1935 is shown below :—

	Number of Doses.			
	1932.	1933.	1934.	1935.
British India.				
Bombay Presidency ...	272,510	597,946	299,208	113,567
Madras Presidency ...	143,516	132,840	124,357	119,919
Bengal, Bihar and Assam ...	30,612	20,310	85,299	60,336
United Provinces of Agra and Oudh.	147,230	70,776	270,998	152,846
Punjab	88,500	123,552	249,867	71,756
North West Frontier Provinces.	306	668	238	15
Central Provinces and Berar ...	41,126	45,176	64,547	33,179
Delhi Province	186	567	526	.....
Burma	60,658	57,732	108,914	131,748
	784,644	1,049,567	1,203,954	683,366
Indian States.				
Southern Maratha Country ...	114,260	95,486	78,267	5,152
Sawantwadi	4,530	3,828	1,008	.....
Baroda	1,890	3,488	16,832	13,008
Hyderabad Deccan ...	172,568	183,812	223,504	214,373
Mysore	261,196	174,786	183,609	81,003
Benares	102	42	60	.....
Patiala	300	102	464	6,416
Jammu	12,378	34,842	41,186	1,995
Jaipur	.....	12	7,716	8,050
Jodhpur	252	120	8	98
Kathiawar	6,012	102	.....	.....
Cambay	.....	258	1,944	.....
Bhopal	660	510	1,840	1,072
Alwar	.....	102	200	.....
Indore	.....	504	1,558	.....
Kashmir	30	5,373	30	.....
Bikaner	.....	66	10,000	.....
Dewas	.....	30	15,504	.....
Cochin	.....	.....	4,602	.....
Rampur	.....	.....	270	1,600
Rewa	.....	.....	.....	260
Faridkot	.....	.....	.....	150
Nabha	.....	.....	80	.....
	574,178	503,463	588,682	333,182
Foreign Countries.				
China	3,120	990	400	.....
Germany	36	.....	.....	.....
Colombo	.....	250	104	.....
Federated Malay States ...	.....	252	912	384
Busra	.....	102	.....	112
Egypt-Cairo	.....	27,054	.....	.....
Singapore	.....	504	.....	.....
Nova Goa	.....	.....	80	.....
	3,156	29,152	1,496	496
Total No. of Doses ...	1,361,978	1,582,182	1,794,132	1,017,044

B.—Epidemiology of Plague.

The Department of Plague Epidemiology under Rao Bahadur G. D. Chitre, in addition to the research work in connection with the relative immunity of rat population in different parts of India—reported in Part II of this Report—carried out the following routine work.

(*a*) *Training of Personnel of Public Health Departments.*

This Institute, in pursuance of its policy of rendering every possible aid to workers in the field in connection with plague epidemiological and preventive work, has been holding classes for training Medical Officers of Health and Sanitary Inspectors of the Presidency and the neighbouring States.

Seven Medical Officers of Health and twenty-six Sanitary Inspectors of this Presidency received training in plague work. In addition, prolonged training was given to several other medical officers, both from Indian States and other provinces, particularly to Medical Officers from Mysore, Travancore, Kolhapur, Hyderabad, and the Punjab.

A class is held every year for the Sanitary Inspectors under training in the Bombay Municipality. Training is also given to students working for the degree of Bachelor of Hygiene at the Grant Medical College, Bombay.

(*b*) *Field Work.*

This Department conducted the following field work at the request of the Director of Public Health for the Government of Bombay, Poona.

(1) During 1933 Chitre was deputed to Poona in connection with the plague epidemic for devising plague preventive measures. Two reports on Rat Trapping and Baiting were drawn up and submitted to the Director of Public Health for the Government of Bombay, Poona.

(2) During 1934 Chitre proceeded to Poona, Bijapur, Belgaum, and Sawantwadi and Kolhapur States where he demonstrated methods of Rat and Flea Destruction with Calcium Cyanide preparations.

(3) Towards the end of 1935 Chitre was deputed on a Statistical Enquiry in connection with plague. Wadgaon Haveli, Shere and Shenoli villages were visited, and a census was taken. As the incidence of plague was very low and owing to a busy harvest season people were unwilling to undergo inoculation against plague, the Enquiry was stopped.

(*c*) *Rat Examination.*

Between two and three thousand rats are caught daily by the Municipal authorities and are sent to the Institute for examination for Plague. This examination is of very great assistance in

spotting an epizootic at its earliest, and thereby enabling the Municipal authorities to take necessary steps. It is to be noticed that no infection at all has been detected in rats for the last eighteen months. Some rats, during this period, did show signs very similar to plague infection, but detailed bacteriological examination showed it to be due to an organism other than *B. pestis*. This organism is being studied further.

The following tables show the work carried out in connection with rat examinations. The live rats brought to the Institute are not examined for signs of plague as it was found on a previous occasion that the examination of dead rats was sufficient to give all the required information regarding an epizootic. Even out of the dead rats a large number has to be discarded because of the putrid condition in which they arrive, rendering them unsuitable for examination.

EXAMINATION OF RATS FOR PLAGUE.

TABLE I.

Rats received at the Institute from the Municipality during 1932-35.

Month.	1932.			1933.			1934.			1935.		
	Alive.	Dead.	Total.	Alive.	Dead.	Total.	Alive.	Dead.	Total.	Alive.	Dead.	Total.
January	23,817	38,645	62,462	24,956	39,296	64,252	25,519	45,208	70,727	38,327	31,330	69,657
February	22,586	37,658	60,244	20,784	38,859	59,643	19,755	42,052	61,807	36,199	33,160	69,359
March	21,325	38,130	59,455	23,260	39,186	62,446	22,730	37,305	60,035	33,866	29,708	63,574
April	22,825	37,547	60,372	21,861	35,077	56 938	28,502	24,911	53,413	30,694	28,933	59,617
May	19,565	24,594	44,159	26,643	35,994	62,637	34,526	23,512	58,038	29,721	27,389	57,110
June	20,447	24,353	44,800	25,480	31,589	57,069	30,255	22,451	52,706	33,488	25,745	59,233
July	19,779	26,625	46,404	24,582	33,377	57,959	31,367	17,777	49,144	34,019	25,082	59,101
August	21,410	33,510	54,920	24,171	36,317	60,488	30,029	23,706	53,735	33,982	24,083	58,065
September	19,140	31,722	50,862	22,301	37,537	59,838	27,947	29,480	57,427	33,765	23,210	56,975
October	22,705	35,494	58,199	26,644	34,596	61,240	39,363	33,565	72,928	40,736	28,547	69,283
November	20,138	33,746	53,884	28,580	39,442	68,022	34,519	33,636	68,155	39,546	27,637	67,183
December	22,248	35,853	58,101	28,578	37,830	66,408	35,069	34,631	69,700	41,655	28,806	70,461
Total ...	255,985	397,877	653,862	297,840	439,100	736,940	359,581	368,234	727,815	425,988	333,630	759,618

TABLE II.

Examination of dead rats for Plague during 1932-35.

Month.	1932.				1933.				1934.				1935.			
	Dead rats examined.	Plague infected rats.	*Rattus norvegicus.*	*Rattus rattus.*	Dead rats examined.	Plague infected rats.	*Rattus norvegicus.*	*Rattus rattus.*	Dead rats examined.	Plague infected rats.	*Rattus norvegicus.*	*Rattus rattus.*	Dead rats examined.	Plague infected rats.	*Rattus norvegicus.*	*Rattus rattus.*
January	26,754	50	44	6	24,263	23	18	5	26,963	0	0	0	20,263	0	0	0
February	27,104	96	85	11	26,741	57	50	7	23,211	11	11	0	24,897	0	0	0
March	23,882	129	120	9	27,043	126	99	27	18,039	16	13	3	19,737	0	0	0
April	26,304	146	128	18	18,859	113	97	16	13,551	1	0	1	20,747	0	0	0
May	16,513	59	51	8	23,259	35	31	4	15,483	3	2	1	20,080	0	0	0
June	16,261	39	35	4	18,816	18	15	3	12,001	2	2	0	17,796	0	0	0
July	19,060	27	25	2	18,704	5	5	0	9,291	0	0	0	17,724	0	0	0
August	22,964	29	27	2	19,591	3	3	0	19,564	0	0	0	15,606	0	0	0
September	21,207	38	37	1	19,437	3	2	1	19,210	0	0	0	13,901	0	0	0
October	22,210	34	31	3	18,754	3	3	0	28,622	1	1	0	18,607	0	0	0
November	24,464	21	20	1	22,582	6	5	1	25,996	0	0	0	20,350	0	0	0
December	25,295	22	20	2	18,851	1	1	0	25,923	0	0	0	16,579	0	0	0
Total ...	272,018	690	623	67	256,900	393	329	64	237,854	34	29	5	226,289	0	0	0

TABLE III.

Relation of human plague deaths to plague deaths among rats.

Month.	1932.				1933.				1934.				1935.			
	Human Plague Deaths.	Rats examined *Post Mortem.*	Plague infected rats.	Percentage Mortality.	Human Plague Deaths.	Rats examined *Post Mortem.*	Plague infected rats.	Percentage Mortality.	Human Plague Deaths.	Rats examined *Post Mortem.*	Plague infected rats.	Percentage Mortality.	Human Plague Deaths.	Rats examined *Post Mortem.*	Plague infected rats.	Percentage Mortality.
January	0	26,754	50	0·2	0	24,263	23	0·0	4	26,963	0	0·0	1	20,263	0	0·0
February	3	27,104	96	0·4	3	26,741	57	0·2	11	23,211	11	0·0	0	24,897	0	0·0
March	6	23,882	129	0·5	12	27,043	126	0·5	8	18,039	16	0·1	0	19,737	0	0·0
April	13	26,304	146	0·6	11	18,859	113	0·6	3	13,551	1	0·0	0	20,747	0	0·0
May	5	16,513	59	0·4	6	23,259	35	0·2	3	15,483	3	0·0	0	20,080	0	0·0
June	0	16,261	39	0·2	2	18,816	18	0·0	1	12,001	2	0·0	0	17,793	0	0·0
July	0	19,060	27	0·1	1	18,704	5	0·0	1	9,291	0	0·0	0	17,724	0	0·0
August	0	22,964	29	0·1	2	19,591	3	0·0	0	19,564	0	0·0	0	15,606	0	0·0
September	2	21,207	38	0·2	6	19,437	3	0·0	0	19,210	0	0·0	0	13,991	0	0·0
October	1	22,210	34	0·2	3	18,754	3	0·0	0	28,622	1	0·0	0	18,607	0	0·0
November	0	24,464	21	0·0	1	22,583	6	0·0	0	25,996	0	0·0	0	20,350	0	0·0
December	0	25,295	22	0·0	1	18,851	1	0·0	0	25,923	0	0·0	0	16,579	0	0·0
Total ...	30	272,018	690	0·25	48	256,900	393	0 15	31	237,854	34	0·1	1	226,289	0	0·0

SECTION II.

DEPARTMENT OF PHARMACOLOGY.

During the period under review the Department functioned from 1st January 1932 to 31st March 1933, when it was closed down on account of financial stringency and was opened again with the generous assistance of the Indian Research Fund Association on 15th October 1935.

In the intervening period the Department did not function at all except for a postgraduate student, Mr. C. R. Mehta, who carried out chemical analysis of the seeds and root bark of the plant *Oroxylum indicum*, Vent., Natural order BIGNONIACEÆ. These are household remedies and have reputation for use in hysteria, diarrhoea and dysentery, rheumatism, dropsy and as an application to foul ulcers!

Chemical nature of the root bark and seeds was investigated. Mehta worked out a new method by which Oroxylin is obtained in a greater yield, i.e., 0·86 per cent. as against 0·2 per cent. by Naylor and Dyer's method.

In this method, powdered root bark is directly extracted in a Soxhlet apparatus with acetone, the concentrated acetone extract poured into dilute alcohol, and the precipitaded crude oroxylin, freed from fatty matter by washing with boiling petroleum ether and cold sulphuric ether is finally crystallised from alcohol.

While agreeing with Naylor and Dyer in carbon and hydrogen values of oroxylin and the presence of benzoic acid as one of the by-products of hydrolysis he found that it contains a methyl group and is di-hydroxy-methoxy-flavone $C_{16}\ H_{12}\ O_5\ C_{15}\ H_7\ O_2\ (OH)_2\ OCH_3$. While according to previous workers, oroxylin dissolves in dilute alkali with a red colour, which rapidly changes to green, he established that this is due to an impurity associated in a small quantity with oroxylin, and oroxylin, freed from this impurity, is stable to alkali in which it dissolves with a permanent deep yellow colour. The colour reaction of this impurity with alkali indicates that the impurity is "baicalein," which probably occurs along with oroxylin.

While investigating the oil from the seeds he found that the unsaturated acids consisted exclusively of oleic acid while saturated ones consisted of palmitic, stearic and probably lignoceric or acids higher than lignoceric acid.

During 1932 the Department carried out the following work:—

A. Indigenous Drugs.

The study of the composition and therapeutic value (*a*) of the bark of *Symplocos racemosa* Roxb., and *Alstonia scholaris* R. Br., (*b*) the leaves of *Hydrocotyle asiatica* Linn., and *Melia azadirachta* Linn., (*c*) the roots of *Saraca indica* Linn., and (*d*) the roots and fruits of *Tribulus terrestris* Linn., was carried out.

Roots and stems of *Tecoma stans* Juss., received from Satara as an antidote for snake-bite and scorpion sting, were found to have no such therapeutic property.

Dr. K. S. Mhaskar read before the Pharmacological Section of the 22nd All-India Ayurvedic Conference held in Bikaner in December 1931 papers on "Gynæcology, Obstetrics and Pediatrics of the Ayurvedists", with special reference to the drugs and treatments employed by them.

B. *Synthetic Compounds.*

Two antipyretics received from the Department of Chemistry, Royal Institute of Science, Bombay, were tested; they failed to produce a lowering of temperature.

C. *Earth-eating and Salt-licking.*

Eight samples of soil from salt-licks in India were analysed and the results have been sent for publication.

From the middle of October 1935, the work carried out is summarised below:—

A. *Pharmacology of Plasmoquin.*

It has been possible to confirm the work of some previous observers and to record some new observations on the pharmacological action of Plasmoquin. The drug has a depressant action on Respiration and Circulation; and intravenous administration in cats, dogs, and rabbits produces slowing and irregularity on the heart. The spleen volume is increased and its rhythmic contractions are augmented, though the latter effect is not very constant. The automatic contractions of the intestines, both *in situ* as well as isolated, are inhibited, the action on the isolated gut being marked, a dilution of 1–500,000 producing a distinct inhibition. The action on the uterus of experimental animals is slight as compared with quinine. *In situ*, the tone of the uterine muscle is slightly increased while isolated uteri of cats, dogs, rabbits and guinea-pigs show an inhibition of contractions after being immersed in a 1–100,000 or stronger concentrations of Plasmoquin.

B. *Insecticides.*

In collaboration with Major R. C. Wats, I.M.S., a study of the insecticidal properties of certain drugs has been undertaken. The technique described by Sinton and Wats in the Records of the Malaria Survey of India in September 1935 was followed, the mosquitoes being used as test insects. The following drugs were used:—

(*i*) *Adhatoda Vasica* Nees. (fresh leaves), (*ii*) *Lantana camara Linn.* (fresh leaves and roots), (*iii*) *Anona squamosa Linn*

(fresh leaves), (*iv*) *Datura alba* Nees Capsules and leaves (fresh), and (*v*) *Uraria crinita* Desv.

None of the abovementioned drugs showed any insecticidal and activity.

C. *Action of Acetylcholine on the Brain.*

Previous observations that injections of small quantities of acetylcholine into the ventricles of the brain of cats produce a condition closely resembling sleep were found to be true for dogs also. For this purpose, small holes were trephined in the skull of dogs and the animals allowed to recover from the operation. A week or more afterwards about 0·01 mg. of acetylcholine was introduced into the lateral ventricle. Typical sleep followed after an interval of about half hour and lasted for about 2 to 3 hours.

Experiments are in progress to see if acetylcholine is liberated into the central nervous system as a result of stimulation of afferent nerves.

D. *Remedies against Snake-bite.*

From time to time, drugs are sent to this laboratory as specific cures for snake-bites. Three such "cures" were examined as they were obtained from "reliable sources", but none of them was found to have any curative effect against Cobra or Viper venom.

SECTION III.

DEPARTMENT OF BIO-CHEMISTRY.

1. Bio-Chemical Studies on Anti-plague Serum.

Right through the period under review the Bio-Chemical Unit has worked on Anti-plague Serum in close co-operation with the Plague Inquiry. An important step in the preparation of a therapeutic serum is the process of concentration. This has to be studied afresh for each therapeutic serum. The Bio-Chemical Unit was ideally equipped and staffed for this purpose. The main datails of the work done is reported under Researches on Anti-plague Serum. Here we shall indicate the main outlines of the work.

The first problem tackled was to determine the critical zones for the precipitation of the various fractions of globulin (Euglobulin, Pseudo-globulin I and Pseudo-globulin II) in the normal serum of the animals used for the production of Anti-plague Serum. The animals immunised by the Anti-plague Serum Inquiry were mainly sheep, buffalo and horse. Hence the normal serum of all these animals was studied. The precipitant chemical selected after several trials was neutral sodium sulphate.

We give below the results :—

Normal Sheep Serum.

Zones—Precipitation with Sodium Sulphate.

Concentration. Gms. of Na_2SO_4 per cent.	Grammes Nitrogen per 100 cc. Sheep A.	Sheep B.
Whole Serum	1·176	1·186
7	1·164	1·184
8	1·161	1·179
9	1·155	1·171
10	1·141	1·163
11	1·124	1·149
12	1·119	1·138
13	1·100	1·081
14	0·918	1·005
15	0·843	0·913
16	0·723	0.759
17	0·670	0·750
18	0·663	0·743
19	0·588	0·678
20	0·500	0·573
21	0·499	0·560
22	0·498	0·493
23	0·481	0·441
24	0·465	0·418
25	0·453	0·391
26	0·429	0·362

Normal Horse Serum.

Zones—Precipitation with Sodium Sulphate.

Concentration. Gms. per cent. of Na_2SO_4.	Grammes Nitrogen per 100 cc. Horse No. 1.	Horse No. 2.
Whole Serum	1·061	1·091
7	1·061	1·083
8	1·057	1·080
9	1·056	1·077
10	1·050	1·075
11	1·033	1·074
12	1·029	1·071
13	1·018	1·052
14	0·989	1·004
15	0·954	0·984
16	0·897	0·905
17	0·879	0·789
18	0·872	0·783
19	0·849	0·767
20	0·774	0·708
21	0·666	0·641
22	0·659	0·635
23	0·577	0·625
24	0·544	0·598
25	0·511	0·560
26	0·495	0·519

Normal Buffalo Serum.

Zones—Precipitation with Sodium Sulphate.

Grammes Nitrogen per 100 cc.

Concentration. Gms. per cent. of $Na_2 SO_4$.	Buffalo No. 24.	Buffalo No. 21.	Buffalo No. 12.	Buffalo No. 10.
Whole Serum	1·116	1·088	1·152	1·039
7	1·113	1·086	1·150	1·039
8	1·113	1·082	1·146	1 038
9	1·109	1·082	1·145	1·038
10	1·106	1·078	1·135	1·036
11	1·100	1·076	1·131	1·030
12	1·076	1·037	1·120	1·026
13	1·065	1·031	1·120	1·018
14	0·977	1·023	1·107	0·962
15	0·851	0·929	0·990	0·854
16	0·743	0·813	0 830	0·792
17	0·628	0·747	0·830	0·772
18	0·618	0·742	0·812	0·763
19	0·580	0·688	0·730	0·662
20	0·549	0·663	0·666	0·608
21	0·519	0·657	0·659	0·601
22	0·510	0·644	0·620	0·591
23	0·498	0·613	0·561	0·536
24	0·466	0·591	0·52	0·491
25	0·441	0·560	0·500	0·449
26	0·402	0·527	0·450	0·417
	12-13	12-13-14	12-13	11-12-13
	17-18	17-18	16-17	17-18
	21-22	20-21	20-21	20-21-22

On the basis of the findings given above the following zones were decided upon :—

Globulin fraction.	Concentration of $Na_2 SO_4$ g. per cent.		
	Horse.	Buffalo.	Sheep.
Euglobulin	12	13	12
Euglobulin + Pseudo-globulin I	18	17	18
Total Globulins :—			
Euglobulin	22	21	21
Pseudo-globulin I			
Pseudo-globulin II			

Each globulin fraction was individually separated and tested on animals as described elsewhere and it was found that in the case of the Anti-plague Serum, as opposed to Antitoxin of tetanus and diphtheria, the curative principle was found to be present in all the three fractions of the globulin. Full details are to be seen elsewhere in this report.

2. *Concentration of Anti-plague Serum.*—After it had been experimentally decided that for concentrating Anti-plague Serum the total globulin fraction must be retained, over 100 litres of serum

have been concentrated during the period under review. The following method was adopted for the purpose :—

Each litre of serum was slowly added to two litres of sterile filtered neutral sodium sulphate solution, containing 31·5 per cent. of anhydrous sodium sulphate, making a final concentration of 21 per cent. Na_2SO_4 in the mixture. This mixture was allowed to stand for 3 to 10 hours, and the precipitate separated by filtration through filtering cloth. The filtering cloths with the precipitate were placed in layers of absorbent cloth or blotting paper and pressed in a mechanical press to dry the precipitate into cakes. This cake of globulin was then scraped off the cloth and put in celophane (600) bags and dialysed in running filtered water kept constantly at 9°C., for about 72 hours or as long as Na_2SO_4 could be detected in the lysate. The globulin thus freed of all Na_2SO_4 was dissolved in saline and the pH was adjusted to 7·4. The globulin solution was then filtered through a Seitz filter, using E. K. Serum Films. The final volume of filtrate was made up to half the volume of the original serum. The sterility of the solution was then tested, and if found sterile, Trikresol in ether (1 to 1) was added to make a concentration of 0·35 per cent.

3. *Normal Clinical Standards for Indians.*—The modern study of disease conditions requires the measurement of various constituents of the blood. For arriving at any estimate of the departure in disease a knowledge of the same constituents in normal adults is essential. Figures for normals so far available are those worked in America and Europe. This Department therefore took up the study to establish standards for normal Indian adults. So far 42 cases have been worked out, and the figures are given below. This study will continue until at least one hundred adults have been examined :—

Table giving data for normal bloods.

Constituent.	Method.	Range.	Average.
Non-protein Nitrogen.	Folin Micro	15·56-21·30 mg. per cent.	18·64 mg. per cent.
Urea Nitrogen	Do.	9·80-14·20 „ „ „	12·09 „ „ „
Uric Acid	Do.	2·16-3·79 „ „ „	3·11 „ „ „
Creatinine	Do.	1·04-1·88 „ „ „	1·31 „ „ „
Total Creatinine	Do.	2·18-3·77 „ „ „	3·05 „ „ „
Amino Acid Nitrogen.	Do.	3·00-5·65 „ „ „	3·95 „ „ „
Chlorides as Na Cl.	Whitehorn	340·00-515·0 „ „ „	433·00 „ „ „
Cholesterol	Leiboff	157·00-227·0 „ „ „	189·00 „ „ „
Inorganic Phosphorus.	Fiske and Subbarow.	2·91-4·52 „ „ „	3·95 „ „ „
Serum Calcium	Clarke and Collip.	8·96-11·04 „ „ „	9·89 „ „ „
Fibrin	Wu and Ling.	0·16-0·31 g. per cent.	0·21 g. per cent.
Albumin	Do.	3·81-5·02 „ „ „	4·24 „ „ „
Globulin	Do.	1·62-3·03 „ „ „	1·93 „ „ „

4. *Plague Antigen.*—The nature of plague antigen has interested this Department for some time and numerous attempts have been made to separate in a pure form, from old growths of *B. pestis* in liquid media, the protein substances which have the property of conferring immunity. Work is still being continued.

5. *Nutritional Work.*—Complete arrangements have been made in this Department to undertake vitamin assay work, and some research work has been carried out. The details are recorded elsewhere in this report.

6. *Snake Venom.*—Recent work has brought into prominence the value of different snake venoms in the treatment of disease. This work is recorded elsewhere in this report.

7. *Routine Examination of Specimens.*—The Department has been made use of increasingly by hospitals and private practitioners for various bio-chemical examinations. The work done during the period under report is given in the following table :—

Routine Examinations carried out during 1932-35.

	1932.	1933.	1934.	1935.
Blood—				
Non-Protein Nitrogen	42	37	40	69
Urea Nitrogen	34	35	44	68
Uric Acid	22	15	13	18
Creatinine	17	17	13	20
Total Creatinine	8	7	...	...
Amino Acid Nitrogen	8	7	...	...
Chlorides	7	11	1	2
Cholesterol	19	17	9	19
Sugar	44	33	44	45
Phosphorus	4	9	5	4
Serum Calcium	10	7	2	4
Plasma Proteins :—				
Fibrin	23	8	2	3
Globulin	42	8	2	3
Albumin	40	8	2	3
Hæmoglobin	35	23	10	20
Cell Volume	4	14	5	10
Indices	4	10	5	...
Van den Bergh Reaction	1	8	3	10
Acetone Bodies	1	...	...	1
Red Blood Cells	...	...	4	...
Icteric Index	...	...	...	2
Andrew's Reaction	...	...	...	2
	370	274	204	303

Routine Examinations carried out during 1932-35—contd.

	1932.	1933.	1934.	1935.
Urine—				
General Qualitative Test	50	32	50	74
Total Nitrogen	12	8	1	8
Urea	5	6	...	9
Uric Acid	12	10	5	4
Sugar	26	22	35	71
Chlorides	4	5	1	2
Phosphates	1	4	...	...
Albumin	9	10	4	5
Acetone Bodies	2	...	...	2
Total Acidity	6	4	1	1
Urobilin	1	1	...	...
Diastase content	...	1	...	...
Oxalic Acid	...	1	...	...
Lactose	1	2	...	...
Blood	...	2	1	...
pH (Hydrogen Ion Concentration)	...	...	1	11
Urea Nitrogen	...	...	5	...
Bile Salts	...	...	1	...
Bile Pigments	...	...	1	...
Test for presence of Lead	...	...	1	...
Urinary Calculus	...	1	2	1
Ammonia	...	...	...	3
	129	109	109	191
Fæces—				
Occult Blood	5	4	2	1
Fat	6	5	1	...
Bile Pigments and Acids	...	...	...	1
	11	9	3	2
Cerebro-Spinal Fluid—				
Total Protein	5	6	12	23
Globulin	5	6	7	20
Chlorides	2	4	...	3
Sugar	2	8	6	2
Phosphorus	...	1	...	...
Lange's Colloidal Gold Test	6	6	15	36
Urea Nitrogen	...	...	1	1
	20	31	41	85
Miscellaneous—				
Glucose Tolerance Test	4	3	3	7
Urea Concentration Test	6	8	9	14
Human Milk Analysis	...	2	...	...
Gastric Analysis	5	4	19	4
Ghee Analysis	...	1	...	...
Basal Metabolism Rate	14	18	11	13
Food Analysis	...	12	...	...
Vomitus (Occult Blood)	...	...	1	...
Ammonia Co-efficient	...	...	...	3
Coagulation Time of Blood	...	...	...	1
Prothrombin Co-efficient	...	...	...	1
Calcium Time of Blood	...	...	...	1
	29	48	43	44
	559	471	400	625

SECTION IV.

DEPARTMENT OF PUBLIC HEALTH CHEMISTRY AND BACTERIOLOGY.

A. Chemical Work.

Waters.—The chemical examination of water forms one of the routine examinations in the Department. Since the advent of the Public Health Laboratory at Poona the number of samples sent to this Institute for examination has diminished. The samples of water are grouped in three divisions, viz. wells, surface waters, and borings. "Surface Waters" include waters from rivers, tanks, and tap supplies—both treated and untreated. The following table shows the figures for the past six years :—

Source.	1930.	1931.	1932.	1933.	1934.	1935.
Wells	16	18	24	1	...	4
Surface Waters	41	15	12	1	...	6
Borings	33	5	2	1	1	2
Total Number ...	90	38	38	3	1	12

The chemical composition of these waters shows extreme variations in total solids and chlorides and very few of the samples come up to the recognised standards of purity.

Other Work : 1932.—Towards the end of the year, this Department had to carry out the fumigation work of the Customs Department as the fumigation plant of the latter was under repairs. In all 74 packages of varying sizes were fumigated with hydrocyanic acid gas.

Two samples of glucose from the Government Medical Stores were examined regarding their suitability for bacteriological purposes.

1933.—A sample of saccharose from the Government Medical Stores was examined as to its suitability for bacteriological purposes.

1934.—Three samples of peptone were examined as to their suitability for bacteriological purposes. Two packages of fruit plants were fumigated with hydrocyanic acid gas for the Customs Department.

One sample of human milk was submitted to chemical analysis.

1935.—One sample of ghee and one of butter were submitted to chemical analysis, and both were found to be of good quality. One sample of peptone was examined and found unsuitable for bacteriological purposes.

The Department carried out fumigation work for the Customs Department. 257 packages comprising fruit trees, flowering trees and cotton were fumigated with hydrocyanic acid gas.

Stains and standard solutions were supplied to some departments of this Institute and various laboratories in the Presidency during the course of the years 1932 to 1935.

B. Bacteriological Work.

During the years under review samples of drinking water were subjected to examination for (1) the number of bacteria per c.c. of the sample aerobically viable on nutrient agar, and (2) the least quantity of the sample that was capable of producing acid and gas in MacConkey's Neutral Red Bile Salt Lactose Broth on 2 days' incubation at 37° C.

The total number of samples of drinking water thus examined yearly are given below. They are classified into 3 groups, viz., wells, surface waters, and borings. "Surface Waters" include waters from rivers, tanks and tap supplies—both treated and untreated.

Source.	1931.	1932.	1933.	1934.	1935.
Wells	2	8	2	2	9
Surface Waters	7	13	4	5	7
Borings	1	...	...	...	...
Total Number ...	10	21	6	7	16

The bacteriological findings of the drinking waters during 1932-35 are shown in the following table:—

Total number of aerobic bacteria per c.c. of sample.	Least quantity of sample fermenting MacConkey's Broth.							Total number of samples.
	No fermentation in 100 c.c.	100	10	1·0	0·1	0·01	0·001	
1—10 ...	.....	...	3	...	...	...	...	3
11—100 ...	5	4	3	2	...	...	...	14
101—1000 ...	2	1	4	4	1	...	...	12
1001—10000 ...	.....	...	2	...	4	2	4	12
Above 10000 ...	1	...	1	1	2	1	3	9
Total Number of samples ..	8	5	13	7	7	3	7	50

From the above table it will be seen that none of the samples used for drinking purposes could be classed as bacteriologically fit for potable purposes.

In addition to the examination of drinking water during 1932 eight samples of water from Breach Candy Swimming Bath were examined. Of these, 3 were found to be of fairly good purity.

During 1934, in addition to samples of drinking water, two samples of water were submitted for specific bacteriological examination, one for the presence of enteric group of organisms and the other for the presence of Cholera vibrio. The examination of the former proved negative while from the latter a cholera like vibrio was isolated.

During 1935, two of the samples of drinking water were examined for the presence of *Cyclops*. One was found to be infected. Three samples of water from Bandra and one from the training ship "Dufferin" were examined specifically, the former for the presence of *V. cholera* and the latter for organisms of the enteric group. The results were negative in all cases.

Besides the water samples, four samples of milk were examined bacteriologically. Of these three samples came from Bandra for isolation of *V. cholera,* and one came from the training ship "Dufferin" for the presence of enteric group of organisms. The specific organisms were not isolated in any case.

In addition cat-gut samples were examined from time to time, for testing the sterility of the tubes.

SECTION V.

VACCINE DEPARTMENT.

A. Vaccines other than Plague.

In former years the Institute was mainly interested in the preparation of plague and antirabic vaccines. In 1934 we took up the preparation of other vaccines as well, e.g., Cholera, T.A.B., and Meningococcus, etc., for use in the Presidency.

The Vaccine Department carried out bottling and sterility tests of all plague vaccine and antirabic vaccine, and in addition manufactured T.A.B., Cholera and Meningococcal vaccines. Autogenous vaccines are prepared from time to time by the Diagnostic Department and form part of the routine work of that Department. Stock cultures of pathogenic organisms were maintained and issued to laboratories.

The amounts of various vaccines prepared and issued are summarised in the following tables :—

Antirabic Vaccine.

	1932.	1933.	1934.	1935.
Brews decanted	1,205	939	858	929
Bottles filled—				
25 cc.	2,465	4,464	3,787	4,373
10 cc.	20,610	20,749	22,351	23,674
5 cc.	50,260	36,396	26,655	31,726
3 cc.	.....	7,909	8,283	8,675
Total ...	73,335	69,518	61,076	68,448.
Bottles tested for sterility ...	2,467	2,041	1,700	1,905
Doses sent to Despatch Department	103,805	.....	5,444	.....
Treatments issued for—				
(*a*) Local use	1,952	2,532	2,581	2,955
(*b*) Out-stations	5,951	5,202	5,093	5,273

The following amounts of other vaccines were prepared and issued. The amounts are in cubic centimetres.

—	1932.	1933.	1934.	1935.
Cholera	1,185	9,790	206,894	406,453
T. A. B.	2,350	3,640	11,240	5,735
Meningococcal	.....	.....	33,897	21,390
Chicken Cholera	370	660	.....	.....

The Department prepared the following amounts of killed Bacterial Emulsions. The amounts given are in cubic centimetres.

—	1932.	1933.	1934.	1935.
B. Typhosus	915	1,350	1,500	4,000
B. Paratyphosus A	800	1,400	1,650	1,800
B. Paratyphosus B	300	825	1,775	1,800
B. Paratyphosus C	.....	500	500	800
Micrococcus melitensis ...	400	.....	125	150
B. Coli	.....	.....	425	1,000
B. dysenteriae, Flexner ...	.....	.....	225	1,100
B. dysenteriae, Shiga ...	.....	.....	150	1,075
B. abortus	.....	.....	.....	50

The following table shows the work done in connection with Stock Cultures :—

—	1932.	1933.	1934.	1935.
Stock Cultures sub-cultured at monthly intervals.	259	292	255	271
Special Cultures of Pneumococcus sub-cultured every four days.	11	14	18	14
Living Cultures of pathogenic organisms issued.	29	38	37	37

In addition the following miscellaneous work was carried out :—

	1934.	1935.
Decanting flasks of :—		
Horse Serum	5	4
Sheep Serum	2	1
Buffalo Serum	1	2
Saline	2	11
Carbolised Saline	4	4
Citrate Saline	3	1
Cyanide T. Sodium	.....	2
Peptone Water	3	1
Distilled Water	1	1
Ascitic Fluid	2	.....
Sodium Solution	1	.....
Methylene Blue	5	.....
Bile	.....	2
Filtered Bile	10	3
T.A.B. Vaccine	10	.....
Dead Emulsion	10	17
Anti-cholera Vaccine	227	.....
Meningococcal Vaccine	29	.....
Plague Vaccine (Experimental)	68	84
Filtered Broth	.....	1
Glucose	.....	2
Calcium Chloride	.....	1
Acid Broth	.....	1
Testing for Sterility bottles of various flasks of Normal Saline and Experimental vaccines.	.....	160

B. Snakes and Snake Venom.

The Institute continued to receive snakes from out-stations and from local sources. Venom was extracted from both Cobras and Russell's Vipers at fortnightly intervals and was issued to various laboratories for experimental purposes.

The following table shows the number of snakes received and the quantity of venom despatched to various laboratories during the years 1932-35 :—

	1932.		1933.		1934.		1935.	
	Number of snakes received.	Venom issued in grammes.	Number of snakes received.	Venom issued in grammes.	Number of snakes received.	Venom issued in grammes.	Number of snakes received.	Venom issued in grammes.
Cobra	7	29·5	26	53·0	65	17	152	348
Russell's Viper	3	25·0	24	51·5	30	66	185	51·2
Echis carinata	222	1·0	...	...	529	2·7	...	...

Research work in connection with Snake Venom is being carried out and is reported in another part of this Report.

SECTION

DIAGNOSTIC

A.—ROUTINE

The routine work carried out is summarised

Material examined.	1932.		
	Positive.	Negative.	Total.
A. Blood—			
(*a*) Films—microscopical examination—			
for malaria	5	43	48
„ differential leucocytic count ...	...	...	16
„ filaria	...	...	...
„ relapsing fever	...	...	...
„ Peroxidase Reaction	...	...	...
(*b*) Count for R. B. Cs.	...	...	4
„ „ W. B. Cs.	...	...	2
(*c*) Cultures for organisms (*B. typhosus, etc.*) ...	...	3	3
(*d*) Serological Examinations—			
Wassermann Reaction*	914	1,542	2,456
Kahn's Test	...	...	...
Formolgel Reaction	...	...	...
Blood Grouping	...	...	34
Agglutination Tests—			
for Enteric group	52	44	96
„ Undulant fever	...	1	1
„ Weil Felix reaction	...	1	1
„ *B. alkaligenes faecalis*	...	...	...
„ *B. coli*	...	...	...
„ *B. dysenteriae*	...	...	...
(*e*) Animal Inoculation for Trypanosome infection...	...	...	...
(*f*) Coagulation Time	...	...	...
Calcium Time	...	...	...
Prothrombin Time	...	...	...
B. Sputum—			
Microscopical examination for *B. tuberculosis*...	6	21	27
Cultures for various micro-organisms ...	...	...	5
Animal Inoculation Tests	...	...	...
Cultural examination for *B. tuberculosis* ...	...	...	...
C. Urine—			
General Analysis	...	...	70
Cultures	...	...	76
Examination—microscopical and animal experiments—for *B. tuberculosis* ...	...	2	2
„ Bilharzia haematobia ...	...	...	...
Aschheim-Zondek Test	...	...	...

* This also includes Cerebro-spinal Fluids, their numbers

VI.

DEPARTMENT.

WORK.

in the accompanying Tables.

1933.			1934.			1935.		
Positive.	Negative.	Total.	Positive.	Negative.	Total.	Positive.	Negative.	Total.
76	138	214	105	215	320	371	471	842
...	...	14	...	...	45	...	...	31
...	...	...	...	2	2	...	3	3
...	...	...	...	4	4	...	...	...
...	...	...	...	...	...	...	...	2
...	...	4	...	...	8	...	...	15
...	...	4	...	...	4	...	...	12
4	20	24	...	16	16	1	13	14
810	1,723	2,533	1,331	1,769	3,100	1,780	2,212	3,992
3	1	4	211	259	470	836	1,104	1,940
...	...	...	...	2	2	...	...	...
...	...	38	...	...	12	...	...	6
41	26	67	27	48	75	22	48	70
...	6	6	...	6	6	...	3	3
2	3	5	...	2	2	...	2	2
...	...	...	...	2	2	...	...	...
...	...	...	...	1	1	...	2	2
...	...	...	1	...	1	...	...	...
...	...	1	...	...	...	...	...	...
...	...	...	...	...	1	...	...	2
...	...	...	...	...	1	...	...	...
...	...	...	...	...	1	...	...	...
9	27	36	13	34	47	11	38	49
...	...	3	...	...	6	...	...	...
...	...	...	...	1	1	...	1	1
...	...	...	...	...	...	...	3	3
...	...	163	...	...	263	...	...	320
...	...	147	135	83	218	88	98	186
...	7	7	...	13	13	1	5	6
...	...	...	...	1	1	...	...	...
...	...	...	...	...	...	1	2	3

for 1932, 1933, 1934 and 1935 being 36, 43, 41 and 66 samples, respectively.

Material examined.	1932. Positive.	Negative.	Total.
D. Faeces—			
(*a*) Microscopical Examination—			
(1) for ova, cysts, amoebae	41	151	192
(2) „ Acid-fast bacilli	1	4	5
(3) „ detection of fat	...	...	...
(*b*) Cultural Examination—			
for cholera, typhoid, dysentery	5	81	86
„ miscellaneous organisms	...	...	83
(*c*) Examination—microscopical and Animal Experiments—for *B. tuberculosis.*	...	...	...
(*d*) Examination of Occult Blood ...	...	...	...
E. Cerebro-Spinal Fluid—			
(*a*) Microscopical Examination—			
for *B. tuberculosis* and other organisms ...	...	12	12
(*b*) Cell Count	...	...	9
(*c*) Cultural examination	2	6	8
(*d*) Animal Inoculation Tests	..	...	...
F. Pus—			
Microscopical and Cultural Examination ...	3	1	4
G. Miscellaneous Smear Examinations—			
Smears for *B. diphtheriae*	1	5	6
„ „ Gonococci	2	5	7
„ „ Leprosy	2	9	11
„ „ Spermatozoa	...	1	1
„ „ *B. pestis*	2	2	4
„ „ Meningococcus	...	...	...
„ „ *B. anthrax*	...	...	...
„ „ *V. cholera*	...	...	...
„ „ Spirillum of rat-bite fever ...	...	...	...
„ „ Treponema Pallidum	...	1	1
Smears from Pleuritic and other cyst fluids for *B. tuberculosis.*	...	3	3
Smears from pus for Echinococcus infection ...	...	1	1
Microscopic examination of hair for fungus ...	...	1	1
H. Miscellaneous Cultural Examinations—			
Swabs for *B. diphtheriae*	1	5	6
„ „ Meningococcus	...	...	...
„ from Nose and Throat	...	...	...
Cultural examinations for Gonococci ...	2	5	7
Pleuritic, Ascitic and other cyst fluids ...	...	...	...
I. Miscellaneous Animal Tests—			
B. diphtheriae	1	5	6
Fluids for B. tuberculosis	...	3	3

Work—contd.

1933.			1934.			1935.		
Positive.	Negative.	Total.	Positive.	Negative.	Total.	Positive.	Negative.	Total.
61	117	178	72	143	215	110	128	238
...	...	..	...	...	...	...	...	...
1	1	2	...	...	...	...	...	...
4	57	61	8	71	79	...	...	...
...	...	72	...	...	...	8	70	78
...	...	...	...	5	5	1	1	2
...	...	...	...	...	...	1	3	4
1	12	13	2	29	31	7	24	31
...	...	12	...	...	22	...	...	34
1	13	14	101	99	200	...	...	...
...	...	...	1	6	7	...	1	1
31	8	39	8	6	14	1	6	7
...	6	6	1	4	5	1	3	4
3	3	6	16	8	24	14	17	31
5	9	14	3	4	7	...	8	8
...	...	...	...	...	...	...	1	1
...	2	2	...	5	5	...	1	1
...	...	...	6	2	8	2	1	3
...	...	...	...	1	1	...	...	...
...	...	...	...	1	1	...	...	...
...	...	...	...	1	1	...	...	...
1	1	2	...	...	...	...	...	...
1	9	10	...	4	4	2	2	4
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	6	6	1	4	5	1	3	4
...	...	...	6	2	8	...	12	12
...	...	35	...	...	...	...	...	22
3	3	6	...	...	...	...	...	...
...	4	4	...	4	4	2	2	4
...	6	6	1	4	5	...	...	...
1	9	10	1	6	7	...	...	...

A.—ROUTINE

Material examined.	1932.		
	Positive.	Negative.	Total.
J. Miscellaneous Work—			
Disinfectants for Carbolic Coefficient ...	...	...	6
Identification of cultures ...	...	...	4
,, ,, snakes ...	...	...	1
,, ,, scorpions ...	...	...	...
,, ,, worms ...	...	...	...
,, ,, insects ...	...	...	...
Sterility Test of Cat-gut ...	...	...	...
,, ,, ,, Medicine Capsule ...	...	...	...
Bacteriological Examination of Oysters ...	...	...	...
K. Supplies—			
(1) *Vaccines:*			
(*a*) Autogenous Vaccines	...	...	66
(*b*) Staphylococcus Vaccine	...	...	...
(*c*) Streptococcus Vaccine	...	...	...
(*d*) Staphylococcus, Streptococcus combined Vaccine.	...	...	40 cc.
(*e*) B. coli communis	...	...	...
(2) *Sera:*			
(*a*) Group Sera	...	...	...
(*b*) High Titre Sera B. Typhosus	...	...	...
B. Paratyphosus A. ...	...	...	...
B. Paratyphosus B. ...	...	...	...
B. Paratyphosus C. ...	...	...	...
(3) *Smears on slides:*			
(*a*) *B. pestis*	...	...	...
(*b*) *B. diphtheriae*	...	...	...
(*c*) *B. anthrax*	...	...	...
(*d*) *B. tetanus*	...	...	...
(4) Antigens for Wassermann Reaction ...	...	...	...
(5) Media Loeffler's Serum Agars	...	...	...

WORK—*contd.*

1933.			1934.			1935.		
Positive.	Negative.	Total.	Positive.	Negative.	Total.	Positive.	Negative.	Total.
...	...	12	...	...	6	...	...	4
...	...	2	...	...	9	...	...	3
...	...	5	...	...	6	...	...	12
...	...	1	...	...	...	...	...	...
...	...	1	...	...	...	...	...	...
...	...	...	...	...	3	...	...	...
...	...	3	...	...	3	...	...	...
...	...	1	...	...	...	...	...	...
...	...	...	...	...	7	...	...	1
...	...	59	...	...	76	...	...	71
...	...	...	...	...	24 cc.	...	...	18 cc.
...	...	...	...	...	12 cc.	...	...	12 cc.
...	...	50 cc.	...	...	...	...	...	...
...	...	...	...	...	6 cc.	...	...	6 cc.
...	...	2 cc.	...	...	8 cc.	...	...	5 cc.
...	...	...	...	...	1 cc.	...	...	...
...	...	..	...	...	1 cc.	...	...	½ cc.
...	...	...	...	...	1 cc.	...	...	...
...	...	..	...	...	1 cc.	...	...	...
...	...	50	...	...	...	...	...	...
...	...	...	...	...	4	...	...	...
...	...	...	...	...	1	...	...	...
...	...	...	...	...	1	...	...	2
...	...	...	...	...	50 cc.	...	...	...
...	...	...	...	...	36	...	...	278

B. Pathological Section.

Table showing the total number of Pathological Tissues received and examined during 1932-35.

	1932.		1933.		1934.		1935.	
	Total.	Percentage.	Total.	Percentage.	Total.	Percentage.	Total.	Percentage.
Non-malignant Tumours ...	69	13·4	46	9·6	66	14·1	57	13·2
Malignant Tumours ...	89	17·3	91	19·0	72	15·3	55	12·8
Tissues found to be normal ...	6	1·2	9	1·9	6	1·3	3	0·7
Miscellaneous pathological conditions	344	66·7	329	68·7	323	68·7	309	71·9
Received in a state unfit for examination	7	1·4	4	0·8	3	0·6	6	1·4
	515	...	479	...	470	...	430	...

TABLE SHOWING THE CLASSIFICATION OF MALIGNANT TUMOURS EXAMINED AT THE INSTITUTE DURING 1932-35.

Table showing the Classification of Malignant

	1932.						
	Carcinoma.	Epithelioma.	Sarcoma.	Endothelioma.	Rodent Ulcer.	Teratoma.	Total.
Lymphatic System—							
Axilla	...	...	...	...	..	...	...
Neck	...	...	...	...	...	...	...
Clavicle region	...	...	...	...	...	...	...
Inguinal region	...	...	...	...	...	...	...
Groin	...	...	...	...	...	...	...
Glands	2	2	1	...	...	...	5
Digestive System—							
Anus	...	...	...	...	...	...	...
Rectum	...	...	...	...	...	...	...
Liver	2	...	...	...	...	...	2
Parotid	...	...	...	...	...	...	...
Pharynx	...	...	...	...	...	...	...
Stomach	...	...	...	...	...	...	...
Tonsil	...	...	...	...	...	...	...
Colon	1	...	...	...	...	...	1
Urinary Organs—							
Kidney	...	...	1	...	...	...	1
Bladder	...	...	...	...	...	...	...
Respiratory System—							
Nose	...	...	...	...	...	...	...
Larynx	...	...	...	...	...	...	...
Male Reproductive Organs—							
Testis	2	...	2	...	...	2	6
Prostate	...	...	...	...	...	...	...
Genital region	...	...	...	...	...	...	...
Penis	...	...	...	...	...	...	...
Prepuce	...	...	...	...	...	...	...
Scrotum	...	...	...	...	...	...	...
Urethra	...	...	...	...	...	...	...

* Secon
† One mixed
‡ One Anaplastic Carcinoma and the
§ Embryonal

Tumours examined at the Institute during 1932-35.

1933.						1934.						1935.						
Carcinoma.	Epithelioma.	Sarcoma.	Endothelioma.	Rodent Ulcer.	Total.	Carcinoma.	Sarcoma.	Epithelioma.	Malignant Teratoma.	Rodent Ulcer.	Total.	Carcinoma.	Sarcoma.	Epithelioma.	Malignant Melanoma.	Seminoma.	Plasmocytoma.	Total.
...	...	...	...	...	...	4	1	...	....	...	5	3	...	...	...	...	...	3
...	...	...	...	...	...	2	...	1	...	...	3	1	...	...	...	...	...	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1
...	...	...	...	...	...	...	...	2	...	...	2	...	...	...	...	...	...	...
2	1	...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1
1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	1	...	...	1
...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	1
...	...	...	...	...	...	2†	...	...	...	...	2	1	...	...	...	...	...	1
...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...
1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...
1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1
...	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...
...	...	1	...	...	1	2†	...	...	...	...	2	...	...	...	...	2§	...	2
2	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...
...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
1	4	...	...	...	5	1	...	1	...	...	2	...	...	...	...	...	...	...
...	1	...	...	...	1	...	...	1	...	...	1	...	...	...	...	...	...	...
1	...	...	...	...	1	1	...	...	...	...	1	1	...	...	...	...	...	1
1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...

dary.
Parotid Tumour.
other Embryonal Carcinoma.
Carcinoma.

Table showing the Classification of Malignant Tumours

	1932.						
	Carcinoma.	Epithelioma.	Sarcoma.	Endothelioma.	Rodent Ulcer.	Teratoma.	Total.
Female Reproductive Organs—							
Breast	10	...	2	...	...	...	12
Cervix	3	5	...	...	...	...	8
Uterus	3	...	1	...	...	...	4
Vulva	...	3	...	...	...	...	3
Ovary	3	...	1	...	...	...	4
Omentum	...	...	...	...	...	...	...
Vagina	...	1	...	...	...	...	1
Skin and Subcutaneous Tissue—							
Abdomen	...	...	...	...	...	...	...
Back	...	...	...	...	...	...	...
Cheek	...	...	...	...	...	...	...
Mouth	...	...	...	...	...	...	...
Buttock	...	...	...	...	...	...	...
Leg	...	...	...	...	...	...	...
Lip	...	3	...	...	...	...	3
Pubis*	...	...	...	...	...	...	...
Face	1	...	...	...	...	...	1
Gums	...	...	...	...	...	...	...
Foot	...	...	...	...	...	...	...
Chest	...	2	...	...	...	...	2
Chin	...	...	...	...	...	...	...
Pelvis	...	...	...	...	...	...	...
Thigh	...	...	...	...	...	...	...
Head	...	...	...	...	...	...	...
Scalp	...	...	...	...	...	...	...
Connective Tissue and Muscles—							
Chest	...	...	...	...	...	...	...
Peritoneum	...	...	...	...	...	...	...
Neck	...	...	...	...	...	...	...
Nose	1	...	...	...	...	...	1
Palate	...	...	...	...	...	...	...

* Chorio Epithelioma.
† One Adamantinoma.
‡ One Melanotic Sarcoma.

EXAMINED AT THE INSTITUTE DURING 1932-35—contd.

1933.						1934.						1935.						
Carcinoma.	Epithelioma.	Sarcoma.	Endothelioma.	Rodent Ulcer.	Total.	Carcinoma.	Sarcoma.	Epithelioma.	Malignant Teratoma.	Rodent Ulcer.	Total.	Carcinoma.	Sarcoma.	Epithelioma.	Malignant Melanoma.	Seminoma.	Plasmocytoma.	Total.
10	...	...	...	...	10	9	...	...	...	...	9	4	...	...	...	...	...	4
12	2	...	...	...	14	13	...	1	...	...	14	8	...	4	...	...	...	13
5	...	...	...	...	5	1	...	1	...	...	2	2	...	1*	...	...	...	3
...	...	...	...	...	...	...	...	1	...	...	1	...	...	2	...	...	...	2
6	...	...	...	...	6	2	...	...	1	...	3	1	...	...	...	...	...	1
1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	2	...	1	...	...	3	1	1	...	...	...	...	2
...	...	...	...	...	...	...	1	...	...	...	1	2	...	...	...	...	...	2
3	2	...	1	..	6	...	1	3	...	...	4	1	...	4	...	...	...	5
...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	2
...	..	...	1	...	1	...	...	...	...	...	...	1	...	1	...	...	...	2
...	1	...	...	...	1	1	...	3†	...	...	4	...	...	...	...	...	...	...
...	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...
...	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...
...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...
1	2	2	...	...	5	...	2‡	...	...	...	2	...	...	...	...	...	...	...
1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
2	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...
1	...	2	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1
...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	1
...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...
1	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...

Table showing the Classification of Malignant Tumours

	1932.						
	Carcinoma.	Epithelioma.	Sarcoma.	Endothelioma.	Rodent Ulcer.	Teratoma.	Total.
Connective Tissue and Muscles—contd.							
Abdomen	...	...	4	...	...	...	4
Head and Neck	4	1	3	...	1	...	9
Back	1	...	...	...	...	...	1
Foot	1	...	1*	...	...	...	2
Glutinal region	...	1	...	...	...	...	1
Groin	...	1	...	...	...	...	1
Thigh	...	1	1	...	...	...	2
Thumb	1	...	...	...	...	...	1
Umbilicus	1	...	...	...	...	...	1
Bones and Joints—							
Arm	...	1	...	...	...	...	1
Scalp	...	...	...	...	...	...	...
Tibia†	...	...	...	...	...	...	...
Ankle	...	...	1	...	...	...	1
Finger	...	...	...	1	...	...	1
Jaw	1	2	1	1	...	...	5
Knee	...	1	1	...	...	...	2
Rib	...	...	...	...	...	...	...
Fæmur	...	...	1	...	...	...	1
Leg	...	...	1	...	...	...	1
Malleolus	...	...	1	...	...	...	1
Special Senses—							
Eye	...	...	...	...	...	...	...
Orbit	...	...	...	...	...	...	...
Eye-lid	...	...	...	...	...	...	...
Total ...	37	24	23	2	1	2	89

* Melanotic Sarcoma.
† Osteo Sarcoma.
‡ Myeloid Sarcoma.

examined at the Institute during 1932-35—contd.

1933.						1934.						1935.						
Carcinoma.	Epithelioma.	Sarcoma.	Endothelioma.	Rodent Ulcer.	Total.	Carcinoma.	Sarcoma.	Epithelioma.	Malignant Teratoma.	Rodent Ulcer.	Total.	Carcinoma.	Sarcoma.	Epithelioma.	Malignant Melanoma.	Seminoma.	Plasmocytoma.	Total.
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	1	1	...	...	2	...	...	...	...	...	...	...	2	...	...	...	...	2
...	...	...	...	...	...	...	...	...	...	...	...	...	1†	1	...	...	...	2
...	...	...	...	...	...	...	...	...	...	...	...	...	1‡	...	...	...	...	1
...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...
...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
1	...	1	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1	...	1	...	...	2	...	1	...	...	...	1	...	...	...	...	...	...	...
...	...	1	...	...	1	...	1‡	...	...	...	1	...	...	...	...	...	...	...
...	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...
57	17	14	2	1	91	45	9	16	1	1	72	28	8	15	1	2	1	55

SECTION VII.

ANTIRABIC DEPARTMENT.

This Department under the charge of Military Assistant H. Maurice, I.S.O., I.M.D., has carried out useful antirabic campaign. During the years under review the antirabic treatment has shown more popularity in the City of Bombay and excellent results have been obtained as shown by the Statistics appended in Part III of this Report. There has been an increase in the number of outstation antirabic centres. There are 62 such centres as against 50 in 1931.

Training of medical officers in antirabic work has continued. The number of medical officers trained was as under :—

1932 ... 8 (3 from Indian States, 1 from G. I. P. Railway.)
1933 ... 8.
1934 ... 3 (Indian States.)
1935 ... 2 (1 from Indian State, 1 from Municipality.)

The treatment at the Institute is summarised below :—

——	1932.	1933.	1934.	1935.
Number of persons applied for treatment.	1,952	2,532	2,581	2,955
Advice Cases	509	784	714	657
Those completed full treatment ...	1,247	1,594	1,830	2,274
Percentage of Health Returns ...	97·9%	97·2%	98·2%	Awaited.
Cases died of Hydrophobia ...	1	1	4	4
Total Mortality Rate	0·24%	0·12%	0·21%	0·17%

The treatment at out-centres is summarised below. The figures are compiled from reports submitted by outstations.

——	1932.	1933.	1934.	1935.
Number of persons applied for treatment.	6,279	5,806	6,437	Treatments issued 5,273 including 255 for Veterinary use.
Number of persons received full treatment.	6,236	5,761	6,397	
Advice Cases	43	45	40	
Cases died of Hydrophobia ...	60	11	34	
Mortality Rate	0·96%	0·39%	0·4%	
Health Returns	76·7%	76·3%	73·6%	

Results of brain examination of animals suspected of Rabies are detailed in the table below :—

Animal.	1932.		1933.		1934.		1935.	
	Positive.	Negative.	Positive.	Negative.	Positive.	Negative.	Positive.	Negative.
Dog ...	152	25	148	52	131	35		
Bullock ...	1	...	...	...	...	...		
Cat ...	3	3	2	...	2	1		
Cow ...	...	1	...	...	...	3		
Donkey ...	...	1	...	1	...	1		
Guinea-pig ...	...	1	1	...	...	...		
Horse ...	...	1	...	...	...	...	Awaited.	
Man ...	1	1	1	...	1	...		
Jackal ...	1	...	...	...	1	...		
Rabbit ...	1	1	...	...	...	...		
Goat ...	...	...	1	...	1	...		
Monkey ...	...	...	...	1	...	1		
Fowl ...	...	...	...	1	...	...		
Total ...	159	34	153	55	136	41		

The positive cases were those in which Negri bodies were found.

The following antirabic treatments were issued to various Veterinary Surgeons for treating dogs and other animals :—

1932.	1933.	1934.	1935.
113	344	287	255

For detailed Statistics see Appendices.

PART II.

RESEARCH WORK.

A. PLAGUE.

(*I*) *Plague vaccine.*—During the years under review Lieut.-Colonel Sokhey, with the assistance of Dr. Maurice, continued researches on Plague Vaccine. He had observed that all investigators, who had reported since the beginning of bacteriological studies of plague, had employed very widely differing experimental conditions, making any comparison of their results impossible. So unstandardised were the conditions of the experiments employed, that even the results obtained by the same investigator at two different times could not be compared, thus leading to contradictory conclusions being put forward. Haffkine had prepared a vaccine consisting of killed broth cultures of *B. pestis* and had shown by controlled field tests that it conferred immunity in human beings. Soon after the German Plague Commission and much more particularly Kolle and Otto (1903-04) reported extensive work, showing that vaccines made from killed cultures gave little or no protection to laboratory animals, especially the guinea-pig. On the basis of this work Kolle and Otto experimented with vaccine consisting of live avirulent cultures. Indeed all their efforts to render virulent cultures avirulent so that they would still retain immunising properties, failed. But they worked with a culture which they found to be avirulent. They observed that the vaccine of live avirulent cultures conferred immunity on guinea-pigs against plague infection. Strong confirmed these results and categorically stated that vaccines made from heat-killed cultures gave no immunity at all.

Other workers obtained still other results and several different vaccines were prepared by different workers among whom were Gaffky, Pfeifer, Sticker and Dieudonné, Lustig and Galeoti, Terni and Bandi, Shiga and Besredka.

Haffkine and other workers in India continued to use heat-killed broth cultures for preparing their vaccines, but some other countries either gave up the use of the plague vaccine altogether or more recently took to using live avirulent cultures as vaccines. Even among those who used heat-killed cultures, there were extreme differences of opinion on many points. Bannerman, and with him one of the Indian Plague Commission had stated, evidently on experimental work, that, in the case of Haffkine's vaccine the prophylactic power resided in the sediment consisting of the killed organisms and that the clear fluid drawn off the vaccine possessed little or no immunising power. Kolle had also obtained the same results. Bannerman when in charge of the Haffkine Institute had recommended that in the preparation of the Haffkine Vaccine the clear fluid of the broth culture of plague organisms should be thrown away and the sediment suspended in saline and used as vaccine.

Recently Schutze reported that vaccine prepared from broth cultures grown at 37° C. possessed higher protective power than those made from cultures grown at 26° C.; and Haffkine Vaccine is made from broth cultures grown at 27° C.

In fact there was no unanimity on any point whatsoever connected with the plague vaccine. At the Haffkine Institute itself the broth cultures had been incubated at various times for periods varying from 3 weeks to 3 months and even more. An enquiry financed by the Indian Research Fund Association was started under Morrison and Naidu in 1923. And though this inquiry worked till about 1929 (from 1925 under Naidu) and published a great deal of work, it in no way clarified the situation. During that period the workers based all their results on measurements of immunity involving the use of *Rattus rattus* (Madras) as the experimental animal, and 0·003 mg. of the spleen of a plague infected rat as the infective dose. This infective dose was given seven days after ½ cc. of a given vaccine to be tested. Usually 60 rats were used for each vaccine to be tested, and the survival rate after 20 days of observation was taken as the measure of the protective value of the vaccine. The validity of this test was questioned, and Naidu duplicated tests on six vaccines to see if his own experiments, done at two different times, agreed. The following results were obtained:—

No. of Vaccine.	Resultant percentage immunity, calculated as the ratio of number of animals surviving to the total number of animals given immunising dose.	
	1st Test.	2nd Test.
60/4	17·3	19·23
65/4	13·6	44·00
61/3	13·6	21·42
64/3	56·6	17·39
60/3	44·4	10·71
62/4	65·2	34·90

This showed that the test devised by Morrison and Naidu could not be relied upon to yield worthwhile data.

At this stage Sokhey with the technical assistance of Dr. Maurice took up the investigation. These workers set themselves to the task of:—

(1) finding the most suitable experimental animal;

(2) measuring the virulence of *B. pestis* cultures;

(3) measuring and standardising the amount and virulence of an infective dose;

(4) maintaining the virulence of *B. pestis* cultures;

(5) studying the best experimental conditions for measuring the immunising power of plague vaccines; and

(6) devising a biological method for measuring the immunising power of a given vaccine so that this method could be carried out in any laboratory by any worker and would yield directly comparable results.

These workers have been engaged on these and correlated problems during the period under review and have been able to successfully solve some of them. This work has shed entirely new light on the problems connected with plague vaccine. A brief account is given below, a fuller account will soon be published elsewhere. The results of this work have already been put to practical use with the result that the vaccine now produced at the Haffkine Institute is found 30 to 60 times as potent as that produced in 1930. The new knowledge, so gained, has also led to the successful preparation of an effective antiplague serum.

1. *Method of Testing the Virulence of Plague Cultures.*—Dr. G. F. Petrie writing as recently as 1929 in Volume III of a "System of Bacteriology in Relation to Medicine" stated that "there is no standard method of testing for virulence" of plague cultures. The consequence of this want coupled with the "difficulty of standardising the experimental conditions in measurements of active immunity is that the results of different workers are not comparable". These gaps in our knowledge have held up all advance in the domain of plague work.

For the measurement of the virulence of a plague culture, (*a*) an accurate measurement of the quantity of organisms used and (*b*) the finding of a highly and uniformly susceptible laboratory animal are necessary.

(*a*) *Measurement of the Quantity of Organisms Used.*—In place of the rough and ready units of measurement so far used by different workers, such as a "loopful from an agar growth", "half an agar slope", "so many ccs. of a broth culture", etc., Sokhey has introduced a method of accurately counting the number of organisms used as an infective dose. He has sought to find the smallest number of organisms of a given culture which would constantly kill a given number of the selected susceptible animal infected.

The counts are done by colony count method. This matter proved to be a source of particular difficulty. So far all the workers who had attempted to make colony counts had used nutrient agar for the purpose. Sokhey found that nutrient agar was not a suitable medium. His observations showed that 0·05 cc. of a given dilution known to contain 2,000 to 5,000 plague organisms carefully spread on nutrient agar of a certain size showed no colonies at all, while the same quantity of even a higher dilution containing from 20 to 50 organisms when spread on 5 per cent. rabbit blood agar of the same size showed 20 to 50 colonies. He has consequently used blood agar throughout his work.

For obtaining suspensions containing known numbers of organisms per cc., serial dilutions in saline are made of 48 hour growth in nutrient broth. The temperature of incubation used is

25°C. and the importance of this temperature will be explained later in this report. During his work Sokhey has made colony counts of hundreds of 48 hour growths in broth and has found between 120 to 260 million organisms per cc.—most often between 120 to 180 million. These counts have been checked by two other methods.

(*b*) *The Test Animals.*—Different workers have used different animals : guinea pigs, white rats, house rats, rabbits and mice. Petrie sums up the prevailing view that " white rats and guinea pigs possess an almost uniform susceptibility to plague, mice are less susceptible, and rabbits are least susceptible to infection ".

The present work shows that the laboratory inbred white mice at the Haffkine Institute are uniformly and constantly the most susceptible animals. As an example one relative susceptibility test out of the several made is given :—

	Number of virulent organisms per animal given subcutaneously.					
	8	40	83	830	8,300	83,000
White Mouse ...	4/5*	5/5	...	...	...	...
Madras-House-Rat (Susceptible).	2/5	2/5	2/5	3/5	...	...
White Rat ...	2/5	5/5	3/5	3/5	...	...
Guinea Pig ...	3/5	4/5	...	3/5	...	1/5

	Number of virulent organisms per animal given subcutaneously.				
	1	12	127	12,700	127,000,000
White Mouse ...	1/5*	5/5	5/5	5/5	5/5

*The upper figure gives the number of deaths and the lower figure the total number of animals used.

Note.—The animals die between the 4th and the 10th day, but the animals are observed for 25 days, so as not to miss the occasional death that takes place later than the 10th day. All animals are killed and post-mortemed at the end of the experiment.

Further evidence that the white mouse is the animal of choice is afforded by the whole of this work. During the last six years, out of the hundreds of control mice, who were given a standard test infective dose, but no vaccine, seldom has a mouse escaped death. To illustrate the point the figures for 1934 are given.

During the year 30 batches of controls were employed (each batch consisted of 5 to 10 white mice) making a total of 179 animals. Members of these batches received from 63 to 212 virulent organisms per individual animal; 178 died and only one survived the infection.

Another set of 13 batches of 5 to 10 white mice per batch, making a total of 81 mice, received per animal between 22 and 51 virulent organisms. All the 81 animals died.

(*c*) *The test.*—A 2 mm. loopful of the culture, of which it is desired to test the virulence, is inoculated into 10 cc. of nutrient broth and incubated for 48 hours at 25° C. 0·5cc. of this subculture is then inoculated into 9·5 cc. of broth and incubated for 48 hours at 25° C. Suitable dilutions in saline are made from this second subculture and required dilutions are inoculated into mice. For each dilution colony counts are made, and a batch of five mice is used.

Illustration Protocols of Virulence Tests.

Culture Number.	Number of organisms per mouse.	Results.
P/25	6	5/5*
	60	5/5
P/5/37	4	5/5
	40	5/5
P/15/37	8	1/5
	80	4/5
P/35/37	90	1/5
	900	4/5
	9,000	5/5
P/40/37	108	0/5
	1,080	5/5
120/5H/37	1,350	0/5
	1,35,000	1/5

Protocols showing Comparative Value of Old Skin Test and the New Test.

Culture P/5/37

Skin test:—(Culture rubbed into a shaved patch of skin of a susceptible rat)		2/2*
New Test	4	5/5
	40	5/5

*The upper figure gives the number of deaths and the lower figure the total number of animals used.

Culture P/15/37

Skin Test ...	...	...	2/2
New Test ...	...	8	1/5
		80	4/5

The old skin test shows both the cultures to be equally virulent while the new test shows the second culture to be 1/10 as virulent as the first.

II. *Maintenance of the Virulence of B. Pestis Cultures.*—In the work on the measurement of active immunity produced by Plague Vaccine Sokhey was baffled for a long time in his efforts to secure a standard infective dose of constant virulence. So far in this laboratory the virulence of strains had been maintained by passage through susceptible animals, the Madras house rat being used for the purpose. He adopted the same method, but soon found it to be unreliable; for some unaccountable reason the virulence of the strain after some particular passage would suddenly diminish.

Such variations in virulence were not noticed before for want of an adequate method of measurement, as shown above; the usual test employed being the skin infection test; but the new method developed and described above brought them out clearly.

Sokhey, therefore, undertook to study ways and means of maintaining the virulence of *B. pestis* cultures. His work soon showed that the temperature of storage was an important factor. Previous workers had reported that plague cultures retain their virulence if stored at room temperature. This was soon found not to be the case—cultures stored at room temperature (25°C), lost their virulence steadily. It was his method of measuring virulence that again enabled him to bring out this fact.

He next tried the higher temperature of 37°C. At this temperature the cultures lost their virulence even more rapidly than when stored at 25° C. Next, lower temperatures were tried. Kolle and Otto had stated that a culture stored by them in an ice box had become avirulent, but an American worker had made the contrary observation. It was decided to test out the effect of storage at low temperature on the virulence of *B. pestis*. With storage in a domestic electric refrigerator maintaining a temperature of 4° C +2° C, it was found that the cultures maintained their virulence. So far all the cultures tested have retained their virulence undiminished and some of these cultures have been in storage for more than three years.

Such observations proved of the greatest value. It has been possible to prepare a constant test infective dose for experimental work, and to develop a quantitative method for measuring the immunising value of a plague vaccine. Further the observations have been of inestimable value in the preparation of plague vaccine and the new antiplague serum.

A protocol to illustrate the maintenance of virulence is given below :—

Date of test.	Number of organisms given subcutaneously per animal	Results.
Culture 120/5H.		
25th October 1932	9	5/5*
	93	5/5
11th April 1933	11	5/5
	112	5/5
15th May 1933	18	5/5
	183	5/5
27th November 1933	11	4/5
	.....	.....
23rd April 1934	12	5/5
	117	5/5
25th October 1934	8	5/5
	80	5/5
19th March 1935	8	4/5
	80	5/5
4th November 1935	8	3/5
	80	5/5
Culture F.		
15th May 1933	9	5/5
	92	5/5
5th June 1933	9	4/4
	97	4/4
8th August 1934	7	3/5
	72	5/5
8th February 1935	8	5/5
	80	5/5
1st April 1935	8	5/5
	85	5/5
7th July 1935	9	4/4
	82	4/4

*The upper figure gives the number of deaths and the lower figure the total number of animals used.

Date of test.	Number of organisms given subcutaneously per animal.	Results.
Culture I.		
11th March 1934	7	5/5
	70	5/5
27th April 1934	12	5/5
	120	5/5
6th June 1934	7	5/5
	67	5/5
6th December 1934	12	5/5
	120	5/5
15th February 1935	8	5/5
	80	5/5
29th March 1935	10	4/5
	100	10/10
23rd August 1935	7	4/5
	70	5/5
21st October 1935	8	5/5
	80	5/5

III. *Optimum Temperature for the Growth of Plague Bacillus.*— Dr. Petris reviewing the existing literature says "The temperature for the growth of the plague bacillus is from 4° to 43° C. *with an optimum at about 30° C.* The success at making exact counts of *B. pestis* has enabled the present worker to solve this point also and he finds that the optimum temperature is 25° C. An illustrative count is given below :—

48 Hour growths in broth at	
37°·5 C.	59 million.
27°·0 C.	116 million.
25°·0 C.	200 million.
24°·0 C.	45 million.

B. pestis ceases to grow at 4° C. ± 2. A 48 hour broth culture containing 135,000,000 organisms per cc. when left in the refrigerator for 4 days showed a count of 129,500,000 organisms per cc. A second broth culture containing 202,000,000 organisms per cc. when left in the refrigerator for 12 days gave a colony count of 211,000,000 organisms per cc.

IV. *A Biological Method for the Standardisation of Plague Vaccine.*—Ever since plague vaccine has been used, workers have held contradictory views, firstly, about the value of the vaccine itself, and secondly about the effect of some of the factors involved in its preparation on the immunising power of the resultant vaccine. There is still no unanimity of opinion as to whether a broth vaccine or an emulsion of a growth on agar is the better of the two. If a broth vaccine, what is the optimal period and temperature of incubation? The Haffkine Vaccine has been incubated at different times for periods varying from three weeks to three months, and even longer. The Haffkine Vaccine is incubated at 27° C to 29° C., while Schutze reported work from the Lister Institute showing that vaccine made from culture incubated at 37° C., is much more potent than vaccine made from cultures grown at a lower temperature. There again is the question of the relative value of vaccines made from avirulent cultures and those made from heat killed cultures. Haffkine's Vaccine is a heat-killed vaccine. These and a heap of other issues had remained undecided for lack of a quantitative method of measuring the immunising power of the vaccine.

Sokhey's success at devising a constant test infective dose and in finding a uniformly and constantly susceptible animal has enabled him to evolve a method in which every factor involved is standardised.

Briefly the method consists in the determination of the smallest quantity of a given plague vaccine which will protect a laboratory white mouse against a given standardised dose of infective organisms. And it may be further added that the method has definitely done away with the so-called "toxic deaths" which resulted from the use of large doses of vaccine. In the author's protocols there is no column for toxic deaths from vaccine, because they simply do not occur.

We will now indicate the standards, without describing the experimental work which has led to their adoption.

(*a*) *The Test Animal.*—Laboratory inbred mouse, over three months of age, weighing between 23 and 28 gm. The original strain was obtained from the Central Research Institute, Kasauli.

(*b*) *Selection and storage of Virulent Strains of Bacillus Pestis.*—Primary cultures from severe septicaemic human cases are obtained by plating venous blood on agar slopes. After four days' growth at room temperature (27 to 32° C.) they are tested for purity. After a culture has been adjudged to be pure, it is next tested for its virulence by the method described above. A large number of subcultures on 5 per cent. rabbit blood agar slopes are then made from the primary cultures of the strains found to be virulent, and sealed and stored in a refrigerator (4° ± 2° C.).

Under these conditions the cultures maintain their verulence for long periods of time—we have tested them now for over three

years and the virulence is undiminished. Whenever a test infective dose is required one of these stored subcultures is used.

(*c*) *Infective Test Dose.*—A virulent subculture stored at 4° C. ± 2° C. is selected and 2 mm. loopful of the growth is sown into 10 cc. of nutrient broth and incubated for 48 hours at 25° C.; then 0·5 cc. of this broth growth is sown into a second tube of 9·5 cc. nutrient broth and incubated at 25° C. for 48 hours. From this second broth subculture 1 in 1,000,000 dilution in saline is made. 0·5 cc. of this dilution per animal is used as the test dose. This test dose contains between 60 and 120 organisms. This infective dose is given seven days after the second portion of the selected doses of the vaccine.

(*d*) *Dose of Vaccine.*—An attempt is made to find the minimum mouse protective dose for a given vaccine, i.e. the amount of a given vaccine that will protect more than half the mice immunised with a vaccine against the *standard test infective dose* as described above. Preliminary trials are necessary to find the approximate mouse protective dose of an unknown vaccine. Four or five graded doses of each vaccine are used, and each dose is given to a batch of five mice. The selected doses are given divided into two equal portions with an interval of seven days.

(*e*) *Duration of the Test.*—The animals are observed for 25 days after the infective dose has been given. This means a total duration of 39 days for each experiment. During this period any animals that die are subjected to smear examinations for the presence of the bacilli in their organs. If none are seen blood cultures are made. If any animal dies, but no plague organisms are detected, the death is noted in the protocols and a note made to the effect that *B. pestis* was not found. Such a happening has been singularly rare. The surviving animals at the end of the 25 days are killed and similarly examined.

(*f*) *Controls.*—For every experiment five or ten mice are used as controls. They are given the *standard test infective dose* but no vaccine. All controls always die, usually between four to nine days after the infection.

(*g*) *Evaluation of Results.*—The smallest dose of the vaccine which saves 3 animals out of 5 is taken as the minimum mouse protective dose. Such a dose must lie about the middle of a series of graded doses of the vaccine used for the particular experiment. That is, among batches which received quantities of the vaccine smaller than the adjudged protective dose, deaths should number more than 3 out of 5 animals used; and among batches receiving higher doses not more than 2 animals should die.

Duplicates are done in all cases and they should agree. If the duplicates show any serious discrepancy the test is repeated.

(*h*) *Protocols.*—During the course of twelve months a large number of vaccines have been repeatedly tested and the method gives consistent results. A protocol of tests on one vaccine to indicate the degree of accuracy achieved is given below.

HAFFKINE PLAGUE VACCINE.

Batch 3,859 prepared on 9th April 1934.

Expt. No.	Date of Experiment	Total Quantity of Vaccine per Animal in Cc.							Number of organisms given as test infective dose.	Controls.
		0·0005	0·001	0·002	0·004	0·008	0·015	0·030		
1	19th July 1934 ...	...	...	...	3/5*	2/5	1/5	0/5	69	10/10
2	13th August 1934 ...	...	...	...	2/5	3/5	1/5	0/5	70	10/10
3	4th October 1934 ...	...	...	...	2/5	2/5	1/5	0/5	115	10/10
4	8th October 1934 ...	...	...	1/5	2/5	1/5	1/5	...	72	5/5
5	18th October 1934 ...	...	...	2/5	2/5	0/5	1/5	...	71	5/5
6	5th December 1934 ...	4/5	2/5	3/5	1/5	0/5	...	...	63	10/10
7	5th January 1935 ...	5/5	2/5	3/5	1/5	...	...	...	98	10/10
8	7th March 1935 ...	4/5	1/5	2/5	1/5	0/5	...	...	80	5/5
	Total for eight ...	13/15	5/15	11/25	14/40	8/35	5/25	0/15	63-115	65/65

*The upper figure gives the number of deaths and the lower figure the total number of mice used. Minimum mouse protective dose = 0·001 cc.

This standardised test now offers the certainty of solving the several problems that await elucidation in connection with the plague vaccine ; for example :—

1. The effects of the temperature of incubation on the immunising property of the vaccine ;
2. The optimum period of incubation ;
3. The relative value of vaccines made from virulent and avirulent strains ;
4. The effects of temperature at which cultures are killed ;
5. The relative value of vaccines made from killed virulent cultures and vaccines made from live avirulent cultures;
6. The much debated point about the relative protective value of the supernatant fluid and the debris in the case of Haffkine Vaccine ; and
7. This method will enable us for the first time to study the relationship between the actual phenomenon of active immunity against a bacterial agent and the serological reaction like agglutination and complement fixation, etc. employed to measure active immunity indirectly.

Work on some of these points is already in progress.

V. *The Relative Protective Value of Different Plague Vaccines.*

After the method had been worked out the relative protective value of the Haffkine vaccine against the protective value of the plague vaccine on the market was measured. For this purpose fresh samples of vaccines were obtained either directly from the laboratories making them or were obtained from the agents in India for the makers.

Following results were obtained :—

Vaccine.	Minimum mouse Protective Dose.	Number of experiments carried out.
Haffkine	0·001 cc.	8
Lister Institute	0·008 cc.	5
Berne Institute	0·015 cc.	4
Pasteur Institute (Paris) ...	0·015 to 0·03 cc.	7
Bayer	0·1 cc.	5

VI. *The Relative Protective Value of Vaccines made from Cultures grown at 27°C., and those grown at 37·5°C.*

The temperature of incubation of plague cultures also deemed to have a great effect on the protective power of the resultant vaccines. In 1932, H. Schutze reported work showing that the protective power of vaccines incubated at 37°C., is much greater than that of vaccines incubated at 26°C. But Schutze used white rats for his experiments, and the survival rate among test animals which had received very large doses of the vaccines as the standard of measurement of the immunising value of the vaccines—a method which, as Sokhey has pointed out gives quite unreliable results.

Further, Schutze reported that the so-called pseudo-capsule of *B. pestis* develops if the organisms are incubated at 37°C. He attributed definite antigenic value to this capsule. The point was of very great importance to this Institute, being the largest producer of Plague Vaccine. Sokhey first repeated Schutze's experiments and got, as he expected, quite conflicting results. Then he measured the protective value of these vaccines by his standardised method and found the vaccines made from cultures at 27°C., appreciably superior to those made from cultures incubated at 37°C. Further, by using Churchman and Emelianoff's recently described method of staining bacterial capsules he has been able to stain the capsule of *B. pestis*. It seems to be a true capsule and is present both when the organisms are incubated at 37°C., and at 27°C.

An illustrative protocol is given below :—

Effect of temperature of incubation, on Immunising power of vaccine.

	Total quantity of vaccine per animal in ccs.						Number of organisms given as test infective dose.	Controls.	Mouse protective dose.
	0·0005	0·001	0·002	0·004	0·008	0·015			
Vaccine—18-B—incubated at 27°C, for 4 weeks.	3/5*	1/5	0/5	2/5	1/5	...	63	10/10	0·001 cc.
Vaccine—18-B—incubated at 37°C, for 4 weeks.	5/5	5/5	3/5	1/5	1/5	...	63	10/10	0·004 cc.
Totals for 4 experiments with vaccine—18-B—incubated at 27° C, for 4 weeks.	8/10	5/10	5/15	6/20	5/15	2/10	63—115	35/35	0·001—0·002 cc.
Totals for 4 experiments with vaccine—18-B—incubated at 37° C, for 4 weeks.	10/10	10/10	8/15	9/20	2/20	...	63—115	35/35	0·004 cc.

*The upper figure gives the number of deaths and the lower figure the total number of animals used.

VII. *Vaccines Made from Heat-Killed Cultures Do Protect Guinea-pigs.*

Almost all the early workers had come to the conclusion that guinea pigs could not be protected against plague by means of vaccines made from heat-killed cultures. Work published by Kolle and Otto was the most impressive and accepted by all workers as final. To 10 guinea pigs they gave three large doses of killed organisms 1, 1½ and 2 agar slopes and to 10 others 1, 1½ and 3 cc. of Haffkine Vaccine. Six weeks later they inducted plague and only one animal out of 20 survived. Inspite of this impressive and unanimous opinion, we decided to test the matter out ourselves, chiefly because we believed that we had managed to produce a vaccine far superior to any produced before. A representative experiment given below shows that even guinea-pigs are as easily protected against plague as our mice with heat killed vacancies :—

Total quantity of Haffkine Vaccine per animal—given subcutaneously—divided in two equal doses with a 7 day interval.	Number of guinea pigs used.	Test Dose.	Deaths.
0·80 cc.	5	1 million organisms.	1
1·25 cc.	5	Do.	0
Controls	5	Do.	5

VIII. *Relative Protective Value of Supernatant Fluid and The Sediment of Haffkine Vaccine.*

Kolle and Otto had found that *the clear fluid* of Haffkine Vaccine which separates out on standing the vaccine for a time had *no protective value*, and that the total protective power of Haffkine vaccine resided in the bacterial debris, so much so that one of the Indian Plague Commissions actually recommended that the clear fluid from the vaccine should be discarded. Our exact methods of measurement have shown that almost the total protective power of Haffkine vaccine resides in the clear fluid. The clear fluid has 300 times the protective power of the debris volume for volume.

IX. *Reaction of the Medium.*

During the course of incubation of *B. Pestis* cultures the reaction of the medium becomes increasingly alkaline. A typical result is given below :—

Period of Incubation.	At 27° C.		At 37·5° C.	
	p H	cc. N/10 acid or alkali required to neutralise 100 cc.	p H	cc. N/10 acid oralkali required to neutralise 100 cc.
Before incubation ...	6·8+	1·4	6·8—	1·4
3 days	6·8—	2·0	6·8—	2·8
1 week	7·4—	3·5	6.8	2·8
2 weeks... ...	8·2—	12·0	7·0—	.....
3 weeks... ...	8·4	20·0	7·6—	4·3
4 weeks... ...	8·4	25·0	7·8	8·0
6 weeks... ...	8·4+	27·5	8·0—	10·5
9 weeks... ...	8·4+	27·3	7·8+	8·3
12 weeks... ...	8·3+	26·8	7·8—	7·4

X. *A Method for rendering B. Pestis Cultures avirulent without destroying their Antigenic Properties.*

Sokhey finds that virulent plague cultures can be rendered avirulent without destruction of their antigenic value by subculturing them at weekly intervals at 37·5° C, for about 60 to 70 weeks.

Some cultures have already been rendered avirulent and several more are in the process of being rendered avirulent. The virulence diminishes gradually and can be stopped at any stage. An illustrative example is given :—

Culture 120/5H.	Number of organisms given subcutaneously per animal.	Results.
Original	9	5/5*
	93	5/5
8th Sub-culture	9	4/5
	92	4/5
16th „	6	1/5
	62	5/5
24th „	6	3/5
	62	5/5
32nd „	6	4/5
	60	4/5
40th „	75	0/4
	750	1/4
48th „	300	1/5
	3,000	1/5
56th „	12,300	0/5
	123,000	0/5
64th „	63,000,000	0/5

* The upper figure gives the number of deaths and the lower figure the total number of animals used.

15 million organisms from this avirulent culture were given intravenously to 3 mice and all survived. But when 1,500 million organisms were given to another batch of mice, they all died from toxaemia. 150 million organisms intravenously killed one out of five from toxaemia.

Next the antigenic value of the avirulent cultures was estimated. It was found that 0·5 cc. (containing 123 million organisms) of a 48 hour broth culture given subcutaneously in two doses, 0·2 cc. and 0·3 cc., at 7 day interval protected all the mice immunised against a standard test infective dose.

XI. *Relative Value of Vaccines made from heat-killed virulent cultures and those made of live avirulent cultures.*

Sokhey was thus in a position to have at one and the same time the same strain of organisms in a fully virulent form and in an avirulent form, making it possible for the first time to measure the protective power of the same strain in two forms. The author made emulsions from 48 hour growths of his 120/5H virulent cultures and of the cultures in avirulent form. Both the emulsions were so standardised that a cc. of each contained 3,000 million organisms. He then measured the protective power of these vaccines by his method of standardising plague antigen.

	Minimum mouse Protective Dose.
Heat-killed Vaccine Strain 120/5H ...	0·002 cc.
Live avirulent Vaccine Strain 120/5H.	0·3 cc.

This experiment shows the heat-killed vaccine to be 150 times as potent as the live avirulent vaccine made from the same strain.

XII. *Why did previous workers fail to protect laboratory animals with heat-killed vaccines?*

The work reported in this report proves conclusively that heat-killed vaccines do confer a very high degree of immunity on white mice. But as the earlier workers, particularly Kolle and Otto, had worked with the guinea-pig, the author experimented with this animal also and found that the guinea-pig can also be readily immunised with heat-killed vaccines.

In view of these results, the failure of previous workers to produce any immunity with heat-killed cultures had puzzled the present author very much. He has made several experiments to find an adequate explanation of this failure.

The temperature at which cultures are killed and the duration of time heat is applied offers an explanation. The present author uses a temperature of 55° C., for 15 minutes, while Kolle and Otto and others used temperatures varying between 60-70° C., for 1 hour. This high temperature when applied for as long a period as 1 hour seems to destroy almost entirely the immunising properties of a plague vaccine.

The author made an emulsion of a 48 hour growth on agar of a virulent strain. This emulsion contained 3,000 million organisms per cc. Half of this emulsion was killed at 55° C., for 15 minutes and the other half at 60° C., for 1 hour. The immunising value of these two vaccines was then tested. 0·002 cc. of the emulsion killed at 55° C, was found enough to protect 4 mice out of 5, but even as much as 0·3 cc. of the emulsion killed at 60° C., for 1 hour gave no protection at all.

XIII. *Changes introduced in the Preparation of Haffkine Vaccine.*

On certain points this work has already yielded definite information and we have changed the preparation of the vaccine to keep pace with our knowledge. A great deal of work, however, still requires to be done, and further changes are likely to result, but we indicate here the changes already introduced:—

(*a*) The vaccine is now prepared from highly virulent strains—first subcultures on blood agar—obtained directly from human cases of plague and stored at 4 ± 2° C. Formerly the vaccine was made from strains passed through Madras house rats (non-immune house rats.)

(*b*) Each batch of vaccine is made from at least five different strains; a single strain was used formerly.

(*c*) The composition of the medium—nutrient broth—and its pH is standardised.

(*d*) A number of other changes—like the period of incubation, the temperature of killing the growth, the methods for testing the purity of each flask of vaccine, etc.—have also been introduced.

The mouse protective dose of the Institute vaccine in 1930 was 0·06 cc. and is now 0·001 to 0·002 cc., i.e., the present vaccine is from 30 to 60 times as potent as before.

XIV. *Reduction of Toxicity of Haffkine's Phrophylactic.*

Haffkine's Phrophylactic Vaccine is undoubtedly possessed of great immunising power, but it has one great disadvantage in that it is very toxic, i.e., it produces severe local and general reaction on subcutaneous inoculation. This question of toxicity has engaged the attention of the author for a long time. First he attempted to reduce it by preparing a vaccine from strains of *B. pestis* rendered avirulent by growing them at 37° C. for some time. This made the vaccine atoxic but also made it lose its protective power. Next antiplague serum was used to reduce the toxicity of the vaccine. It was found that this measure made the vaccine atoxic but destroyed its protective power. A mixture of Plague vaccine and Normal Buffalo Serum was tried next. Normal serum also rendered the vaccine atoxic. The effect on the immunising property of the vaccine is however still under investigation. Even if the Buffalo Serum did reduce the toxicity of the vaccine and did not interfere with its protective power it would not be a practical proposition to add serum to the vaccine for fear of producing serum reactions. A suitable substitute was looked for and was found in Gum Ghati

A solution of Gum Ghati of specific gravity 1,025 gave as good results as the serum. Further tests are being made and the mode of action of the gum is being studied.

II. Antiplague Serum.

Early work with the Buffalo.—During the first two years of the period under review the buffalo continued to be used as the animal of choice for the preparation of the serum. Naidu had selected this animal because it is liable to suffer in nature from a septicæmia somewhat akin to plague, and because the previous workers had employed the horse for the purpose and had failed to get a serum of any definite therapeutic value. In addition Naidu experimented with sheep and calves.

During that period Naidu immunised about 10 buffaloes, 30 sheep, 1 bullock and 3 calves, and obtained about 46 litres of immune serum.

Potency Tests on Rabbits.—Naidu tested the curative value of some of these sera on rabbits. The rabbits were infected with an infective dose, consisting either of 0·003 mg. of plague spleen or of 1 cc. of broth culture containing between 4,000 and 10,000 *B. pestis.* The infective dose was given subcutaneously and the serum intravenously, the first dose of 1 cc. serum being administered 24 or 48 hours after infection and a similar dose repeated on two subsequent days. Most of the sera so tested were of good quality, saving 60 to 80 per cent. of the infected rabbits. The results of these tests are tabulated below :—

Source of Serum.	Date of experiment.	Dose of Serum.	Number of Doses.	Interval after infection hours.	Rabbits treated.	Per cent. Survivors.	Controls.	Per cent. Survivors.
Bullock 2 ...	4th February 1932.	1 cc. ...	3	24	5	100·0	5	0·0
Buffalo 5 ...	Do. ...	1 cc. ...	3	24	15	80·0	5	0·0
Buffalo 2 ...	2nd June 1932 ...	1 cc. ...	3	48	15	60·0	5	20·0
Bull Calf 8 ...	Do. ...	1 cc. ...	3	48	15	60·0	5	20·0
Bull Calf 6 ...	16th August 1932...	1 cc. ...	3	48	5	60·0	5	0·0

Bactericidal power of Antiplague Serum.—Wagle developed a technique for testing the bactericidal power of antiplague serum. The method is as follows :—A set of five small tubes is taken. In each of these five tubes, a different number of organisms is added and then four drops of antiplague serum are added to all the tubes and the tubes are shaken gently. 0·5 cc. of normal rabbit blood is then added to all the tubes; the tubes are gently shaken and the blood is allowed to clot. Each tube of the set, therefore, contains the same amount of antiserum and normal rabbit blood, but varying number of organisms. A control set is put up by using normal serum instead of antiserum, other constituents remaining the same. The tubes are finally corked and incubated at 37° C. for 72 hours and then the contents plated. It has been possible by this method

to show that the antiserum exerts a bactericidal action on a fairly large number of *B. pestis*.

Results of Plating the Contents after 72 hours.

Kind of Serum.	Number of organisms in each tube.				
	1	2	3	4	5
	21,100	2,110	211	21	2
Control—					
Normal Buffalo Serum ...	*	*	*	*	†
Buffalo Antiplague Serum.	†	‡	0	0	0

Note.—*, †, ‡ show different degrees of growth.
0 = No growth.

If human normal blood is substituted for normal rabbit blood, similar results are obtained. In general buffalo and sheep sera show the highest bactericidal power while calf serum shows the bactericidal property only to a slight degree.

Experiments to estimate antitoxic value of the sera are so far inconclusive, but these are being continued by revised methods. There are some indications, however, to show that the serum can effect neutralisation of the toxin to some extent if it is brought into contact with the plague toxin before inoculation into experimental animals.

Concentration of Serum.—Naidu (in 1932) took some of the immune serum to Europe and concentrated it into different fractions and using the rabbit method obtained the following results :—

Source of Serum.	Serum or Fraction.	Number of experiments.	Dose of serum or fraction.	Number of doses.	Interval after infection.	Rabbits treated.	Per cent. survivors.	Controls.	Per cent. survivors.
Buffalo No. 4 ...	Serum ...	1	1·0 cc.	3	48	5	80·0	5	0·0
	Albumin ...	1	0·5 cc.	3	48	5	40·0	5	0·0
	Felton ...	1	0·5 cc.	3	48	5	40·0	5	0·0
	Euglobulin .	1	0·5 cc.	3	48	5	80·0	5	0·0
	Pseudoglobulin.	1	0·5 cc.	3	48	5	80·0	5	0·0
Sheep Nos. 31 and 33.	Serum ...	1	1·0 cc.	3	48	5	80·0	5	60·0
	Albumin ...	2	0·5 cc.	3	48	10	30·0	10	30·0
	Felton ...	2	0·5 cc.	3	48	10	50·0	10	30·0
	Euglobulin .	2	0·5 cc.	3	48	10	70·0	10	30·0
	Pseudoglobulin.	2	0·5 cc.	3	48	10	60·0	10	30·0

It is to be noted that in these experiments though Euglobulin and Pseudo-globulin gave the best results, even the albumin fraction saved 30 to 40 per cent. of the animals treated. Later work reported below showed that these attempts at measuring the curative power of the serum and its fractions gave highly misleading results. The albumin fraction had not been known before to have any protective value. This was clearly brought out by later work.

A new Biological Method for measuring the relative protective value of Antiplague sera.—The results of animal tests reported above were so unsatisfactory that Sokhey and Maurice worked out a new biological method on the same lines as their biological method for measuring the relative immunising value of antiplague vaccines. The method aims at a quantitative measurement of the minimum amount of serum that would protect more than half of the animals inoculated with a measured amount of test dose of *B. pestis* given at the same time as the serum; but separately from it. It was insisted upon that duplicate tests should give reasonably close results.

(*a*) *Test animals.*—Laboratory bred white mice, about 3 months of age, weighing between 23 and 28 g. are used. Usually five mice are used for each dose of the serum.

(*b*) *Dose of the serum to be tested.*—Graded doses of the serum to be tested are used and are decided upon by preliminary tests. The serum is injected subcutaneously over the left shoulder of the animal.

(*c*) *Test Dose of Plague.*—0·5 cc. of 1 : 1,000,000 dilution in saline of a 48 hour broth culture of a virulent strain of *B. pestis* of known virulence is given per animal subcutaneously over the right flank. A strain of plague of such virulence that 3 to 12 organisms per white mouse would kill every animal infected is used for the purpose.

(*d*) *Duration of Test.*—Animals are observed for 25 days after inoculation. Those that die during the experiment are examined for the presence of plague; those remaining alive at the end of the experiments are killed and similarly examined.

(*e*) *Results.*—The dose of the serum that saves at least 3 animals out of five is considered the minimum dose required for protection.

Results such as given below are obtained :—

Number of Serum.	Dose of Serum per Animal.	Infecting Dose.	Number of mice used.	Plague deaths.
Buffalo No. 6 ...	*1st Test (8th May 1933).*—			
	0·3 cc.	56 organisms .	4	2
	0·5 cc.	Do. ...	4	1
	Controls	Do. ...	4	4
	2nd Test (22nd May 1933).—			
	0·3 cc.	28 organisms .	4	1
	0·5 cc.	Do. ...	4	0
	Controls	Do. ...	4	4
	3rd Test (7th August 1933).—			
	0·05 cc.	16 organisms .	5	4
	0·1 cc.	Do. ...	5	3
	0·3 cc.	Do. ...	5	0
	0·5 cc.	Do. ...	5	1
	Controls	Do. ...	5	5

New work on Concentration of Serum.

(*a*) *Fractionization of Antiplague Serum into different protein fractions.*—Sokhey and Gokhale made determinations to find out the concentration of Sodium Sulphate necessary to separate out the immunised buffalo serum into Euglobulin, Pseudo-globulin I, and Pseudo-globulin II and Albumin fractions. For this purpose different concentrations of $Na_2 SO_4$ from 7 per cent. to 24 per cent. varying by 1 per cent. differences were employed. The figures of these tests are given under work done by the Department of Bio-Chemistry on the subject. Thus 12, 18 and 22 per cent. concentration of $Na_2 SO_4$ were decided upon for the separation of Euglobulin, Pseudo-globulin I and Pseudo-globulin II, respectively; the albumin fraction was obtained by 40 per cent. concentration.

(*b*) *Protective Power of the different Fractions.*—Sokhey and Maurice measured the protective value of the different fractions obtained by the method described above and obtained the following results. Serum of Buffalo No. 6 was used for the purpose :—

—	Dose per mouse.	Infecting Dose.	Number of mice used.	Plague deaths.
Euglobulin	0·2	16 organisms ...	5	0
	0·3	Do. ...	5	0
	0·5	Do. ...	5	0
Pseudo-globulin I ...	0·2	Do. ...	5	0
	0·3	Do. ...	5	1
	0·5	Do. ...	5	1
Pseudo-globulin II ...	0·2	Do. ...	5	2
	0·3	Do. ...	5	3
	0·5	Do. ...	5	1
Albumin	0 2	Do. ...	5	5
	0·3	Do. ...	5	5
	0·5	Do. ...	5	5
	Controls ...	Do. ...	5	5

As a result of this experiment it was decided to retain all the globulin fractions and discard merely the albumin fraction. These findings are different from those of anti-toxic sera—in the case of anti-toxins Euglobulin is usually not found to have any protective value.

(*c*) *Concentration of the Serum in bulk.*—Sokhey, Gokhale and Malandkar concentrated about 30 litres of the antiplague serum prepared by Naidu. Sodium sulphate was used right through, and as it had been decided to retain all the globulin fractions, precipitation was carried out with 21·3 per cent. concentration of the salt. Dialysis was carried out in water constantly kept

at 9°C. It was found possible actually to concentrate the serum eight-fold, but it was not considered advisable to do so, because the resultant solution was found to be too thick. 2-fold or 1½-fold concentration gave a more manageable product.

Tests of the Serum in the field.—The epidemic at Poona offered the necessary opportunity. Naidu, Mhaskar and Wagle carried out the tests at the Infectious Diseases Hospital during the months of September to November. Buffalo serum was used throughout. Of the patients admitted to the Hospital only half were treated with the serum and the other half were kept as controls and received the usual treatment from the regular staff of the Hospital. No attempt was made to select cases for serum treatment; on the contrary every effort was made to see that controls resembled the serum treated cases by treating alternate cases. Following results were obtained :—

	Cases.	Deaths.	Case Mortality.
Treated with Serum ...	179	108	60 per cent.
Controls	167	143	85 per cent.

Considering the type of cases dealt with, the results are encouraging. Almost all the patients belonged to the poor, ill-nourished classes and they invariably came to the Hospital comparatively late in the course of the disease. A very large number of cases were severe septicæmias (96 cases), representing most often an advanced state of infection and a number of them died within a short period after admission. Still the results show (1) that at least 25 per cent. more lives were saved by the serum, (2) that buffalo serum is not toxic and (3) that the therapeutic results obtained at Poona with buffalo serum over a larger number of cases compare equally well with those obtained with sheep serum during a limited experiment at Hyderabad-Deccan in 1931.

Later work on the Horse.

Laboratory Tests.—It is to be remembered that human cases showing severe bacteriemia represent late stages of the disease. Patients are reluctant to come to hospital and most of them come only when a fatal termination stares them in the face. During the work at Poona because a number of cases died within a few hours of coming to the hospital, it was rightly believed that the serum did not get a fair trial. Sokhey therefore attempted to devise laboratory experiments to enable him to get a more correct estimate of the curative value of the serum.

Sokhey's work on plague vaccine reported above in its main outlines had given a great deal of information that we did not possess before. He had noticed that in the case of Haffkine Institute laboratory inbred mice bacteriemia developed in hundred per cent. of the animals injected with his standard infective dose.

He studied the matter specially and found that in the case of mice, bacteriemia usually developed in about 72 hours after the induction of injection subcutaneously. On the basis of this observation, he developed a test for testing the therapeutic value of any given antiplague serum.

On testing the buffalo immune serum he found that if he started giving the serum intravenously 72 hours after inducing infection and repeated it at 24 hours' intervals he could prolong the life of treated animals to even as long as 25 days—ordinarily infected mice die in from 5 to 10 days—but could not prevent a fatal termination. These experiments gave him a clear idea of the value of the serum. The serum was not good enough to prevent death if once bacteriemia had developed.

Horse Immune Serum.—Buffalo Immune Serum clearly then was not a serum of very great value in the treatment of plague. Col. Sokhey therefore took up experiments with the horse again. His work on plague vaccine, reported above, had given him a great deal of new knowledge on the properties of *B. pestis*—a knowledge which justified this new step. He with the aid of Dr. Maurice immunised some horses with avirulent and virulent cultures.

Laboratory Tests.

(1) *Prophylactic Potency Tests.*—In addition to the therapeutic test described above he had developed another test to measure quantitatively the minimum amount of a given serum that would protect the laboratory inbred mouse against his standard test infective dose of *B. pestis*, given at the same time as the serum.

By this test he compared the relative prophylactic potency of his new Horse Immune Serum and the Buffalo Immune Serum with the antiplague sera on the market. He obtained the following results.

	Prophylactic Mouse Dose.
Haffkine Institute New Horse Serum ...	0·05 cc.
Haffkine Institute New Buffalo Serum ...	0·3 cc.
Pasteur Institute, Paris, Horse Serum ...	0·5 cc.
Lister Institute, London, Horse Serum ...	0·5 cc.
State Serum Institute, Vienna, Horse Serum.	0·5 cc.

The new serum, by this test, is 10 times as potent as the other sera on the market and 6 times as potent as our own buffalo serum.

(2) *Therapeutic Laboratory Test.*—He tested his new serum by his therapeutic test, which consists of the administration of serum intravenously to mice 72 hours after the induction of plague infection, i.e., the administration of serum after bacteriemia has resulted. By this test he found that his new serum saved animals, where no other serum saved them before. He found that 0·6 to 0·9 cc. of his serum saved 70 to 80 per cent. of the animals. This seemed to be a very conclusive demonstration of the very high curative power of the new serum.

Concentration.—Horse Serum was also fractionized on similar lines to those reported above and Euglobulin and Pseudoglobulin fractions were found to be both possessed of curative power. All the horse serum was therefore concentrated with 21 per cent. concentration of Sodium Sulphate.

Field Tests.—We have not had a suitable opportunity yet to test our new serum in the field. We made an attempt at Bellary recently, but because of the paucity of cases no conclusive results were reached. (See page 6.)

(III) Plague Phage.

Sokhey and Maurice carried out an investigation in connection with Plague Phage which was kindly supplied by Dr. d'Herelle.

In the case of cholera, typhoid and other intestinal infections, it has been difficult to assess the value of phage in the animal body for lack of an animal experiment. As soon as we had developed an almost perfect animal experiment in the case of plague, we undertook to test plague-phage. In vitro experiments it proved to be very potent—it lysed in 1 in 1000 million dilution the plague strain which we used in our experiments. The following experiments were performed and they show that phage has little or no action in the body.

(*I*) *Protective Power of Plague Phage.*

	Infective Dose Number of organisms.	Number of mice used.	Plague deaths.
1st Experiment— 0·3 cc. of phage per animal, and 14 days later infective dose; phage given subcutaneously.	43	5	5
Controls— (*a*) only infective dose given	43	5	5
(*b*) 0·004 cc. vaccine and 14 days after infective dose .	65	5	0
2nd Experiment— 0·3 cc. of phage per animal and 4 days later infective dose; phage given subcutaneously.	43	5	5
Controls: only infective dose given	43	5	5

	Infective Dose Number of organisms	Number of mice used.	Plague deaths.
3rd Experiment—			
Infective dose of organisms suspended in 0·5 cc. of saline given subcutaneously to each mouse. This raised a bulla under the skin. Into this bulla 0·3 cc. of phage was injected immediately following the injection of the infective dose.	78	5	3
Controls	78	5	5
4th Experiment—			
Phage mixed with plague suspension in a test tube—0·2 cc. of phage to 0·5 cc. of suspension containing 100 organisms. 0·7 cc. of this mixture was injected subcutaneously per animal.	100	5	4
Controls	100	5	5

(2) *Curative Power of Plague Phage.*

	Infective Dose Number of organisms.	Number of mice used.	Plague deaths.
1st Experiment—			
Infective dose subcutaneously and *three* doses of phage, each dose 0·3 cc. given intravenously 24, 48 and 72 hours after the infective dose.	38	5	5
Controls : only the infective dose given	38	5	5
2nd Experiment—			
0·3 cc. of phage per animal subcutaneously over the left flank and at the same time the infective dose subcutaneously over the right flank.	35	5	5
Controls—			
(*a*) only infective dose given	35	10	10
(*b*) 0·1 cc. immune serum in left flank and infective dose in right flank.	35	5	1
3rd Experiment—			
0·3 cc. of phage per animal given by mouth at the same time as infective dose given subcutaneously.	35	5	5
Contro's	35	5	5

(IV) Chemotherapy of Plague.

In 1932, Col. Taylor and Wadia carried out an investigation in connection with the Chemotherapy of Plague.

1. *Halogenomercuriphenols.*

As the "in vitro" experiments had shown that these compounds have no greater germicidal value than mercuric chloride, it was decided to see how the toxicity values compared. A series of experiments showed that injected either subcutaneously or intravenously the halogenomercuriphenols are 3-7 times less toxic than mercuric chloride.

Previous work on the treatment and cure of plague infected rabbits using seven out of these ten drugs subcutaneously had given encouraging results occasionally, e.g., partial inhibition of septicaemia, complete sterilisation, prolongation of life, and survival.

But the number of animals used for each drug was so small that no scientifically correct evaluation of these results was possible; because of the inconsistency and variability of these results the intravenous route was tried. However the toxicity of these drugs, when used intravenously, is so high that daily treatment over an extended period, becomes impracticable; in view of this fact the intravenous use of these drugs was not attempted and it was decided to give a more extended trial to difluoromercuriphenol, a drug the subcutaneous use of which had given very promising results in previous experiments. Four batches of four rabbits were given until death or nine days—48 hours after plague infection—two 12 hourly doses daily totalling 4, 3, 2 and 1 mg. per kilo respectively.

The first three batches gave entirely negative results, e.g., no restraint of septicæmia or prolongation of life or survival; the dose of 1 mg. per day rendered all the rabbits sterile, and one animal out of that batch survived. This result was not deemed encouraging enough, and so the chemotherapy of plague by means of halogenomercuriphenols was discontinued.

2. *Proprietary Drugs.*

(*A*). The failure of halogenomercuriphenols to be effective in the treatment and cure of plague led to the trial of two patent drugs, merthiolate and salyrgan.

Merthiolate.—Merthiolate is a mercury complex of ethyl-thiosalicylic acid. It is a very stable powder (also remaining unaffected for months in dilute solutions of Borax), very easily soluble in water, does not precipitate proteins from their solutions, has a high diffusibility in body fluids, and a very low toxicity for all laboratory animals. These properties indicated the fact that it is the nearest approach to the ideal of the chemotherapeutists. One toxicity experiment showed that, when given intravenously even

in as low a dilution as 1 in 1000, a severe edema of the ear, obliteration of veins, localised gangrene and other complications ensue making daily treatment impossible; lower concentrations are not practical to work with because of the considerable quantities that would have to be injected to keep up constantly in the circulation a desirable concentration of the drug. Its use had therefore to be abandoned after one experiment.

Salyrgan.—This compound is a mercury complex of sodium-salicyl-allyl-amino acetate; its physico-chemical and biological properties are identical with those of merthiolate, but it has the additional advantage of being easily sterilisable and of being used intravenously or subcutaneously in concentrations as high as 1 in 100 without any localised or systemic untoward effects due to the concentration in which it is used. The chemotherapeutic action of salyrgan was studied on English and Belgian rabbits (intravenously) and on Madras Rats (subcutaneously).

In the first experiment three batches of four English rabbits were given—48 hours after plague infection—two equal 12-hourly doses totalling 5,3 and 1 mg. per kilo daily; the drugging was continued until death ensued and was stopped on the ninth day after plague infection in the case of survivors; four plague controls were used alongside. All the results were negative in the first two batches; but in the third batch (1 mg. per kilo daily) one only out of the four died; from the plague controls three out of four died.

In the second experiment eight English rabbits were given the drug and four used as plague controls; the treated animals had 1 mg. per kilo daily in two equal 12-hourly doses until death ensued—the treatment starting 48 hours after plague infection. One treated rabbit and one plague control survived but the treated ones died much earlier than the plague controls. On post-morteming the whole lot the majority showed definite evidences of their suffering from an intercurrent disease, resembling bacillary dysentery.

The third experiment with English rabbits was done on lines exactly similar to No. 1, the dosage in this experiment being 9, 6, 3 and 1 mg. in three equal doses; this batch of English rabbits showed more clearly than the preceding one evidences of the same type of intercurrent disease. English rabbits had therefore to be given up in favour of the hardier Belgian rabbits.

The fourth experiment was done on Belgian rabbits. Four batches of four rabbits were given once daily 6 mgrs. per kilo; the drugging starting 6 hours, 48 hours, and 72 hours after plague infection for each batch; eight plague controls were used. Though there is no evidence of arrest of septicaemia, every batch shows a considerable prolongation of life.

These few experiments with salyrgan on rabbits have shown that like the halogenomercuriphenols, this drug is more effective in repeated small doses than in one large one; the smaller the repeated doses the more effective they are than larger repeated ones; the later the treatment is began the better. Unfortunately at this stage further supply of Belgian rabbits was unavailable, and therefore Madras

rats had to be used. The three chemotherapy experiments performed with salyrgan on Madras rats show results identical with those obtained with rabbits, with a greater percentage of survivals.

(*B*). *Trypa-flavin (Bayer).*—This drug was reported to retain its bactericidal power in blood. Sokhey and Maurice tested its action in experimental plague infection in mice. Two experiments were carried out. In the first experiment, soon after the induction of infection 0·5 cc. of a 1 : 1,000 solution of Trypa-flavin was given to each mouse intravenously. All the animals died of plague. In the second experiment, three repeated doses of 0·5 cc. of 1 : 1,000 solution of Trypa-flavin were given to each mouse intravenously, one immediately after infection and the others at 24 hour intervals. All the animals again died of plague.

(V) Serology plague.

During the work on the production of Antiplague Serum Sokhey and Maurice had developed exact quantitative methods for measuring the protective and therapeutic value of the sera produced. These methods, though exact require a large number of mice and involve a period of about a month for each test. It was, therefore, considered desirable to develop serological methods to see if they could be made to replace the biological test. Furthermore, the exact relationship of the serological tests to biological reactions are not known and this was considered to be an excellent opportunity of gaining knowledge in this field of bacteriology.

Greval and Dalal worked out a technique of agglutination and complement deviation reactions. Their results have been published (Ind. Jour. Med. Res., XXI, 283, 1933). A short summary is given here. For the agglutination and absorption tests they used a suspension of the sediment from an eight weeks' growth of *B. pestis* in broth killed at 55° C., for 15 minutes. The sediment was suspended in normal Saline containing formol 0·05 per cent. and phenol 0·25 per cent. For complement deviation test the method and reagents employed were similar to those for Wassermann reaction, except that the antigen consisted of a double dilution of filtered supernatant fluid from Haffkine's Plague Vaccine. The work at this stage stopped because of Greval's transfer from the Institute.

Later Wats and Wagle took up the study and found that the above technique described by Greval was not sensitive enough. They have, therefore, developed a new technique.

(1) Agglutination.

I. Reagents.

(*i*) *The Suspension.*—An emulsion in saline of a 48-hour growth of *B. pestis* on agar is adjusted to No. 10 Brown's Opacity Tubi. This emulsion is frozen (carbon dioxide snow) and thawed (water bath 50°C.) twenty times and diluted with saline and its opacity adjusted to No. 2 Brown's Tube.

(*ii*) *The Serum.*—Various dilutions in saline of the serum to be tested.

II. The Test.

Equal volumes of the suspension and the serum dilutions are put into tubes and shaken well. The tubes are then placed in a water bath at 56°C., for four hours and then transferred to an incubator at 37° C., and left overnight.

The results are recorded as under :—

+ + + = a thick deposit at the bottom with a clear fluid.
+ + = a well-marked deposit at the bottom in a less clear fluid.
+ = a well-marked flocculation in a definitely opalescent fluid.
+ = a definite flocculation detected by a hand lens only.
+ = no change when compared to the original suspension.

III. The Specificity of the Reaction.

Normal horse serum has given a negative reaction.

The different immunised horses in the Haffkine Institute give the following reactions :—

Dilutions of Serum.	Serum of					Normal Horse Serum.
	Horse No. 2	Horse No. 5	Horse No. 6	Horse No. 10	Horse No. 11	
1 in 100 ...	+ + +	+ + +	+ + +	+	+ + +	—
1 in 200 ...	+ + +	+ + +	+ +	+	+ + +	—
1 in 400 ...	+ + +	+ + +	+ +	−	+ + +	—
1 in 800 ...	+ +	+ +	+	−	+ +	—
1 in 1,200 ...	+	+	+	−	+ +	—

It will be seen that whereas no reaction takes place with a normal horse serum the immune sera give marked agglutinations. Work is proceeding on these lines.

(2) Complement Fixation.

I. The Reagents.

(*i*) *The Hæmolytic System.*—As prepared for Wassermann reaction and is used in the same proportions. For the titration of the complement method No. 4 of the Medical Research Council (1928) has been followed.

(*ii*) *Saline* as used in Wassermann reaction.

(*iii*) *The Antigen.*—One mm. loopful of a blood agar growth of *B. pestis* is inoculated into 10 cc. of nutrient acid-digest broth and incubated for 24 hours at 37°C. Then 0·5 cc. of this subculture is added to 10 cc. of Papain Broth (standardised to contain 3500 mg. of Nitrogen per litre) and incubated at 37° C. for 5 days. To this growth is then added 0·5 cc. of Plague phage. This is now incubated for another 24 hours and used as Antigen.

The antigen if stored in a refrigerator (4° C. ± 2) can be used for about two weeks after which it becomes anti-complementary.

(*iv*) *The serum.*—Various dilutions in saline of the serum to be tested.

II.—The Ensemble.

	Serum Dilution.	Serum Control.	Antigen Control.
Serum Dilution	1 volume	1 volume	Nil
Antigen	1 „	Nil	1 volume
Saline	Nil.	1 volume	1 „
Complement 3 M. H. D.	1 volume	1 „	1 „

The above reagents are put together and treated in the following order :—

(1) Serum dilution and antigen are mixed well by shaking and kept in the refrigerator (4° C. ± 2) for one hour ; then (2) Complement is added ; (3) tubes are left at room temperature (24°-29° C.) for half an hour ; then (4) transferred to a water bath at 37° C., for half an hour.

One volume of sensitised red cells is now added and the mixture incubated in a water bath at 37° C. Lysis and inhibition is noted immediately and then again after a night's storage in a refrigerator.

III.—Reading of the Results.

The readings are :—

5. for the complete deposit of the red cells with a clear supernatant fluid.

The lower numbers 4, 3, 2 and 1 are given according to the lysis and the clearness of the supernatant fluid.

IV.—Specificity of the Reaction.

Normal horse serum does not deviate the complement in presence of the above antigen. Tested in this way, the different immune horse sera of the Haffkine Institute react as follows :—

Dilutions.	Horse No. 2.	Horse No. 5.	Horse No. 6.	Horse No. 10.	Horse No. 11.
1 in 100	5	5	5	...	5
1 in 200	5	5	5	...	5
1 in 400	5	5	5	...	5
1 in 800	5	5	...	...	4
1 in 1,200	3	5	...	...	...
1 in 1,600	3	5	...	...	...

The practical application of these methods is still in an experimental stage but the following references illustrate their utility.

1. *Standardisation of Antiplague Serum.*—Though there is some correlation between the results obtained by the adoption of the serological methods and the biological tests (Sokhey and Maurice), the results do not run parallel. The serum of a normal horse gives

consistently negative results and the immunisation of a horse raises the titre for complement fixation tests. In one instance though the high titre was indefinitely retained as shown by the serological tests, the serum had lost more than half of its therapeutic value as shown by animal experiments.

2. *Differentiation of different Strains of B. pestis.*—Six rabbits were immunised with 6 different cultures of *B. pestis*, four having been obtained from various parts of India, one from Egypt, and one from China. Differentiation was then sought by means of complement fixation reaction, agglutination and absorption tests. Each serum from the rabbits was tested with its homologous and heterogenous antigens. The agglutination, absorption and complement deviation tests confirmed each other. From the results thus obtained it has been possible to establish that China strain differs antigenically from the Indian and the Egyptian strains, the latter being exactly alike.

It is hoped to publish the details of the above experiments as a separate paper in the near future.

(VI) Epidemiology of Plague.

(*i*) *Susceptibility to Plague of Rats from different parts of India.*—An Enquiry financed by the Indian Research Fund Association was started in July 1931 in order to determine the relative susceptibility of rats to plague from different places which had suffered from epidemic plague in varying degrees some time or other during the present pandemic (1897-1935).

This survey was continued during the years under report, and the major part of India, i.e., Bombay, Madras, the United Provinces and the Punjab was covered, including Hyderabad and Travancore States. Towns and cities of different provinces were selected so that places with high, low and medium aggregate plague death rate per million were included. Attempts were made to procure at least 80 rats from each place selected. The batches of rats thus procured were observed for a period of 14 days at the place of collection to exclude any possibility of carrying infected rats to Bombay. On arrival at the Institute those animals were further observed for another period of 14 days to see that they were all healthy. From each batch only adults were then selected for the experiments, and divided into two almost equal batches. These batches were then inoculated with the standardised infective dose at two different times with an interval of 14 days, as described by Sokhey and Maurice in another part of this report (Part II, page 60).

With every batch so examined a control batch of Bombay rats, which are highly immune, and a batch of Madras rats, which are very susceptible to plague, were also infected.

The results are summarised in the table below and they show that the percentage of deaths from plague amongst rats after experimental infection has a general correspondence to the aggregate incidence of plague in the area from which rats were obtained. As soon as the Presidency of Bengal has been covered the results will be published in an extended form.

Table showing Incidence of Plague and Percentage Deaths from Plague in Inoculated Rattus rattus :—

Name of Province.	Name of City or Town.	Aggregate Human Plague Death Rate per mille (1899 to 1929).	Percentage Death Rate from Plague in Inoculated rats.
Bombay	Chiplun Town ...	2·73	34·0
	Ahmedabad ...	56·53	15·6
	Surat City ...	101·11	20·0
	Bijapur ...	167·58	0·0
	Bombay City ...	199·88	7·9
	Dhulia ...	206·32	20·5
	Ahmednagar ...	209·28	23·4
	Chopda Town ...	233·21	16·7
	Sholapur City ...	272·37	5·9
	Karachi City ...	315·54	17·1
	Nasik City ...	363·43	0·0
	Belgaum ...	387·78	0·0
	Wai City ...	418·27	4·8
	Poona City ...	430·42	10·0
Madras	Madras City ...	0·396	91·1
	Madura	2·74	91·5
	Calicut ...	9·77	71·7
	Mangalore ...	75·60	35·2
	Salem ...	127·03	79·7
	Coimbatore ...	132·62	17·9
	Vaniyambadi ...	254·85	79·6
United Provinces ...	Dehra Dun ...	12·69	35·0
	Banda ...	26·64	37·5
	Almora ...	46·33	93·0
	Meerut City ...	69·26	7·7
	Cawnpore City ...	169·04	4·2
	Chandausi Town ...	238·06	10·8
	Ballia Town ...	258·35	4·5
	Mubarakpore ...	459·13	4·3
Central Provinces ...	Chanda ...	25·09	92·5
	Jubbulpore City ...	353·92	24·3
	Nagpur City ...	261·87	43·2
Punjab	Dharamsala ...	0·00	100·0
	Ferozpore ...	45·67	20·0
	Amritsar ...	55·14	9·1
	Lahore City ...	1·2	11·3
	Ludhiana ...	15	10·0
	Ambala City ...	217·92	5·6
Travancore State ...	Peermade ...	.....	92·0
	Trivandrum ...	.....	72·2
Hyderabad-Deccan ...	City and Suburbs ...	.....	51·7

(ii) Rat and Flea Survey from the ships in the Bombay Harbour and the Bombay Port Trust Docks Area.

At the request of the Port Health Officer, Bombay, an investigation was undertaken to determine whether the rat and flea population of the steamers visiting the harbour belonged to the same species as the rats and fleas in the docks area. The enquiry was carried out during the years 1924 and 1935.

The following results were obtained and are tabulated in the accompanying tables.

(A) Rat Population.

Source.	Total No. of rats.	Species.													
		Rattus rattus.	Per cent.	Rattus norvegicus.	Per cent.	Gunomys varius.	Per cent.	Bandicota indica.	Per cent.	Mus musculus.	Per cent.	Crocidura cærulea.	Per cent.	Unfit for identification.	Per cent.
Dock Area ...	2,990	1,902	63·6	274	9·2	581	19·4	1	0·0	105	3·5	49	1·7	78	2·6
Ships ...	1,667*	873	52·4	120	7·2	1	0·0	0	0·0	662	39·8	0	0·0	11	0·6

* In addition to these, 131 received during the first six months of 1934 were not identified.

(B) Flea Population.

Source.	No. of rats on which fleas counted.	Total No. of fleas.	Species of Fleas.																Unfit for identification No.	Per cent.	Average No. of fleas per rat.
			Xenopsylla cheopis.				Xenopsylla astia.				Xenopsylla brasiliensis.				Others.						
			Male.	Female.	Total.	Per cent.	Male.	Female.	Total.	Per cent.	Male.	Female.	Total.	Per cent.	Male.	Female.	Total.	Per cent.			
Dock Area ...	2,662	10,203	2,339	2,333	4,672	45·8	1,726	3,259	4,984	48·9	47	61	108	1·1	0	3	4†	0·0	435	4·2	3·8
Ships ...	212	294	136	133	269	91·5	10	10	20	6·8	0	0	0	0·0	0	0	0	0·0	5	1·7	1·4

† The sex of one of these is not recorded.

(VII) Rat and Flea destruction.

1. *A method for measuring the Relative Potency of certain Proprietary Calcium Cyanide Preparations.*

In the past rat baiting and trapping combined with the use of kerosene oil emulsions have been our chief methods of attack. These methods did not prove to be effective; the results obtained were hardly commensurate with the amount of labour involved. But the position has been entirely changed by the advance of industrial chemistry, which has placed at our disposal a number of Calcium Cyanide preparations which, when suitably used, ensure a rapid and effective destruction of rodents, and what is very important, their fleas. Baiting and trapping of rats did not affect the flea problem at all.

The various calcium cyanide preparations on the market were originally designed as insecticides for fruit gardens and other purposes and it was necessary to see which of them would be most suited for rat destruction in burrows and houses in India. With this object we have developed a method for measuring the relative effectiveness of various compounds for our purpose.

The method consists in the determination of the minimal quantity of the product required to kill all the rats and fleas exposed to the product in an artificial burrow of a given size.

A. *Calcium Cyanide Preparations tested.*

(a) Cyanogas "A" Dust (prepared by the American Cyanamid Co., New York), a very finely divided powder, contains about 40 per cent. of calcium cyanide—the rest being inert matter. When it comes in contact with atmospheric water vapour it readily gives off hydrocyanic acid gas. The sample used for these tests, on analysis, showed a $Ca(CN)_2$ content of 42·30 per cent. and an HCN content of 23·31 per cent.

It is sold on the market in 5 lbs. 20 lbs. and 100 lbs. air-tight tins.

The makers also sell a specially made Foot Pump for the application of the dust. This pump produces a dust cloud and forces it into the underground passageways of the burrowing pests.

(b) Calcid Briquettes (prepared by Deutsche Gesellschaft für schädlingsbekampfung—Frankfurt a. M.) are small tablets weighing about 20 g. each, of pressed calcium cyanide (calcium cyanide content being about 88 per cent). The sample used in these tests, on analysis, showed a $Ca(CN)_2$ content of 84·94 and an HCN content of 46·80 per cent.

The Briquettes are sold in 4 Kg. hermetically sealed tins.

A special apparatus for using the preparation is provided by the makers. It is a combined grinder and blower. It grinds the tablets to a very fine powder and as they are being ground a powerful fan blows the powder into the burrow. The blower is worked by hand.

B. *Description of the Burrow in which the experiments were carried out.*

A channel dug in the ground, 4″ wide, 3″ deep and 166″ long, divided into four equal portions and each succeeding portion placed at right angles to the one before it. The four portions were separated from each other with pieces of expanded metal. The channel was roofed with glass sheets, held down at the sides with mud and the channel made impermeable to air wherever necessary with the liberal use of plasticine.

C. *Method of Testing.*

For each test, two adult rats and five fleas in a muslin bag were introduced into each section of the burrow except the first, making six rats and fifteen fleas in all. These fleas and rats were introduced into each section through small traps in the glass roof of the burrow.

The product to be tested was blown in from the opening of the burrow into the first section containing no rats, and the opening at the other end was blocked with mud at the first sign of the escape of the powder from that end, but the blowing in of the product was continued until a predetermined amount of it had been blown in. Calcid was blown in with the Calcid Baby Blower and Cyanogas "A" Dust with the Cyanogas Foot Pump.

After a given quantity of the product had been blown into the burrow, a process which took only a fraction of a minute in the case of Calcid and a little longer for Cyanogas 'A" Dust, a stop watch was started and the rats were watched through the glass roof for signs of cessation of breathing; and as soon as they appeared to be dead, the time was noted and the glass roof removed to expose the rats to fresh air. But the rats were left in the open channel for another ten minutes and then put in cages and removed to a room and examined after 24 hours. The time of exposure in the tables given below is the time between the blowing in of the product and the removal of the glass roof. The number of escapes are the animals that were found alive on the second day in cages. As regards fleas, muslin bags containing them were removed from the burrow at the same time as the rats and the fleas were emptied into glass jars covered with muslin and examined the next day.

TESTS.

A. *Cyanogas "A" Dust.*

No. of *Experiment.* 3rd Series.	Amount of Dust used.	Duration of exposure before breathing apparently stopped.	*Deaths.* Rats.	*Deaths.* Fleas.
1	64 g.	2·5 minutes.	6/6*	15/15*
2	38 g.	5·0 ,,	4/6	13/15
3	42 g.	10·0 ,,	6/6	15/15
4	26 g.	20·0 ,,	2/6	11/15
5	35 g.	20·0 ,,	4/6	12/15
6	17 g.	†	2/6	13/15

* The lower figures give the total number of animals used and the upper figures give the number of deaths.

† Were left in the burrow for 20 hours

B. *Calcid Briquettes.*

No. of *Experiment.* 1st Series.	Amount of Dust used.	Duration of exposure before breathing apparently stopped.	*Deaths.* Rats.	*Deaths.* Fleas.
1	17 g.	2 minutes.	6/6*	15/15*
2	8 g.	3½ „	6/6	15/15
3	4 g.	6 „	6/6	15/15
4	2 g.	9 „	6/6	13/15
5	1 g.	9 „	6/6	14/15
6	0·5 g.	30 „	0/6	6/15

* The lower figures give the total number of animals used and the upper figures give the number of deaths.

Relative Potency of the two Products tested.—The above tables show that at least 42 g. of Cyanogas "A" Dust were needed to kill all the rats and fleas in the burrow, while as little as 1 g. of Calcid was found to be enough. These tests thus show that Calcid is 42 times as effective as Cyanogas "A" Dust. But it must be noted that the HCN content of Calcid is only twice as much as that of Cyanogas "A" Dust. The noted greater effectiveness of Calcid obviously depends on the blower provided by the makers. It grinds the solid very finely and then blows it into the burrow with sufficient force to carry the powder all over the burrow quickly and evenly, while in the case of Cyanogas "A" Dust the blower is not so good; it deposits considerable part of the powder in the section of the burrow nearest to the blower and only a small portion is carried into the sections further away from the nozzle of the blower, that is why no rats or fleas were put in the section of the burrow nearest to the blower.

The makers of Cyanogas "A" Dust have now sent a new pump with a cut-out. This pump, we believe, will give much better results. Experiments are proceeding.

2. *Experimental Fumigation of Houses.*—The residential quarters in India vary from a palatial building to a thatched mud hut. The ventilation varies according to structural differences being controllable in the well-built pucca quarters. On the other hand, though no obvious windows or ventilators exist in the mud huts of the masses, the chinks and interspaces in the walls and roof cannot be made adequately air-tight for purposes of fumigation. Keeping the above in view, we selected various kinds of constructions for our experiments. Though the work is still in hand, the following illustrations might prove of practical importance to workers engaged in antiplague work. As Calcid Briquettes were found to be the most efficacious in the case of burrow fumigation, these were again used by means of the "Baby Blower" except in the last experiment.

Three types of dwellings classified according to the degree of air-tightness attainable were selected. The following work has been carried out, but has not reached finality, and we give some results as a preliminary report.

I. *Capable of being rendered almost air-tight.*

The experimental room with a cubic capacity of 5,681 ft., having a concrete roof, tiled floor and pucca (brick and mortar) walls was fumigated with 360 g. of Calcid briquettes (63·4 g. per 1,000 c.ft.). The room was left undisturbed for 17 hours; out of 15 rats and 36 fleas, 1 rat was the sole survivor. This animal was sheltered in a partially closed dealwood box amongst books.

II. *Capable of being partially rendered air-tight.*

(*a*) The Institute Motor Garage with a cubic capacity of 1,800 ft. and a wooden roof covered by Mangalore tiles with walls and floor of bricks and mortar was rendered air-tight to some extent by use of cotton waste. This garage had wooden doors with a triangular interspace at the top, closed by matting. Two experiments were carried out using 120 g., and 180 g., representing 66·7 g., and 100·0 g., per 1000 c. ft. In the first experiment one rat and eight fleas survived out of five rats and fifteen fleas, respectively, even though the room was kept shut for 21 hours. The increased dosage in the second experiment killed all rats and fleas after an exposure of 2 hours only.

(*b*) The Institute Washerman's shed consisting of a pucca built room with a roof covered by Mangalore tiles supported by wooden battons was selected for fumigation. The cubic capacity of the structure was 5,280 ft; cotton waste was used to close the air chinks. A little over 100 g. of Calcid was used for every thousand c. ft., the period of exposure being 2 hours. 8 rats and 39 fleas were all found dead.

(*c*) A Watchman's hut situated on the side of a quarry with a constant breeze blowing in the environment was selected for the experiment. The cubic capacity of the structure was 1,625 feet; the roof was covered by country tiles which allow plenty of ventilation as compared to Mangalore tiles mentioned above. The walls were made of rusty corrugated iron sheets with several small holes and the floor was kutcha (mud). No attempt was made to cover the roof but the main inlets of air were plugged with cotton waste. About 150 g. and 200 g. per 1,000 c.ft., were unsuccessfully employed, 17 rats and 14 fleas out of 23 rats and 29 fleas used surviving in the two experiments carried out. The experiment was repeated after covering the roof and about 3 feet of the upper part of the walls with tarpaulin pieces. About 150 g. of Calcid per 1,000 c.ft. were blown in but owing to accidental blowing off of the roof cover, the experiment had to be terminated after 45 minutes. In spite of the short exposure only 1 rat survived out of 12 rats and 10 fleas. This rat was placed in a mud chulha (stove), and seems to have escaped due to its partially sheltered location.

III. *Capable of not being rendered air-tight.*

A dilapidated thatched hut without doors consisting of 3 cubicles formed by partitions which did not quite reach the roof, was next selected and attempt was made to make the roof air-tight by covering it with tarpaulin. These pieces of tarpaulin however were not long enough to close in the junction of the walls and the eaves. The door spaces were closed in with paper and a hole here and there was stuffed with cotton waste. The cubic capacity of the structure was 4,417 c.ft. In the first experiment 140 g. of Calcid per 1,000 c.ft., were blown in the central cubicle; it was noted after an exposure of 2 hours that 4 out of 12 rats and 6 out of the 14 fleas had survived.

In the second experiment about 400 g. of Calcid per 1,000 c.ft., were blown in and a similar exposure was allowed. In this case, however, the total amount of Calcid decided upon was divided into three equal portions and each portion blown into each of the 3 cubicles. 3 out of 12 rats and 1 out of 14 fleas survived.

The third experiment was similar to No. 1, except that 400 g. of Calcid and a large and more efficient Pump (Degesch No. 6) was used instead of the " Baby Blower "; the total quantity was blown into the central cubicle, the nozzle of the hose being 2 feet below the roof. All the 14 fleas died, but 1 rat out of 12 survived. This animal had been placed in a mud chulha (stove) as in a previous experiment.

The length of exposure and the quantity of Calcid required to kill the rats and fleas placed in various sheltered locations have not yet been worked out. Work is proceeding.

B. Tuberculosis Enquiry.

(Under the Indian Research Fund Association.)

The Inquiry was continued by Dr. Soparkar and his assistants at the Haffkine Institute.

Filtrable Phase of the Tubercle Bacillus.—In the report for the previous year evidence was brought forward in support of the existence of a filtrable phase of the tubercle bacillus. Interesting findings were obtained during the period under review in connection with the characters of the phase which appeared to be entirely different from that of the original strain used for filtration. Five strains of this phase obtained from the passage animals inoculated with the filtrates were studied. These strains, for convenience will be referred to as "Filtrate Strains". Changes were observed in them both in relation to pathogenicity as well as cultural characters, and the results may be briefly summarised.

Changes in Pathogenicity.—The first strain studied was derived from human sputum. The original strain isolated directly from the sputum showed characters of the human type—both cultural as well as pathogenic. It was virulent for the guinea-pig, producing in this animal fatal generalised tuberculosis in 54 days, but was non-virulent for the rabbit and also for the fowl. The

" Filtrate Strain " obtained from the second passage animal was likewise virulent for the guinea-pig, but in the rabbit it produced lesions resembling those with the avian tubercle bacillus. Another " Filtrate Strain " obtained from a later passage animal, however, became non-virulent for the guinea-pig and had lost all the characters of the human type, and presented those of the avian bacillus alone.

Similar results were obtained with another strain (F. E. 39) also derived from human sputum. Additional facts noted about the instability of this culture were that the " Filtrate Strain " obtained from the eighth passage animal in this experiment, which was kept in artificial cultivation for a year, remained virulent for the guinea-pig, producing in that animal generalised tuberculosis. After ten months more of artificial cultivation, however, its virulence for this animal had considerably diminished and it had no pathogenic effect upon the fowl. But another " filtrate strain " of the same virus obtained from a further passage animal, while remaining non-virulent for the guinea-pig, had acquired high virulence for the fowl which died of an acute infection after inoculation with one-tenth of the dose which previously had no pathogenic effect upon the bird.

The third strain studied (F. E. 40) was also obtained from the filtrate of tuberculous sputum. The original strain was found to be virulent for the guinea-pig, but not for the fowl or the rabbit. The " filtrate strain " obtained from the eighth passage animal showed different characters from those of the original sputum culture. It now was non-virulent for the guinea-pig and the fowl and of low virulence for the rabbit. But these characters soon changed in the case of another strain of the same virus derived from the ninth passage animal, which was still non-virulent for the guinea-pig but highly virulent for the fowl, and had acquired characters of the avian bacillus.

Two more strains were obtained from the filtrates of emulsions of tissues of animals inoculated with known bovine bacilli. One of these was derived from a sambhar from the local zoological gardens. The original strain from it showed characters of the bovine type, being virulent for the guinea-pig and rabbit but not for the fowl. But the culture obtained from the filtrate through a passage animal was now non-virulent for the guinea-pig but virulent for the fowl, and in the rabbit it produced chronic lesions resembling those with the avian bacillus. The other strain studied was derived from filtrate of emulsion of tissues of animals inoculated with the bovine strain obtained from Dr. Stanley Griffith. The original strain was typically bovine but the " filtrate strain " obtained from the seventh passage animal showed loss of characteristic virulence for the guinea-pig and also for the rabbit and was non-virulent for the fowl. Another " filtrate strain " of the some virus obtained from a further passage animal, however, showed that it had developed characters of the avian type and was now virulent for the fowl and the rabbit but not for the guinea-pig. These results point to the gradual loss after filtration of original

characters and virulence of human and bovine types and the acquisition of characters of the avian type with an intermediate stage in which the avian characters had not fully developed.

Changes in Cultural Characters.—The cultural characters of these strains also showed a marked change. For example while the original strain obtained from sputum showed on glycerinated media a dry wrinkled growth, characteristic of the human tubercle bacillus, the "filtrate strains" from the same sputum were moist and slimy and resembled cultures of the avian tubercle bacillus. This change was very marked in experiments with bovine bacilli in one of which, while the original strain grew sparsely on glycerinated media, the "filtrate strains" derived from the same source grew on this medium as a thick moist slimy film.

Colony Formation.—The appearance of the colonies in the blood culture of the fowls inoculated with the "filtrate strains" also showed a considerable variation. Some of them were about 1-2 mm. in size, hemispherical in shape, white, moist and glistening. On glycerinated media their size was larger (3-5 mm.). After some weeks in some of the tubes numerous excrescences were found to have grown over the whole surface of the original white colony giving it a mulberry appearance. In other a thin layer of growth appeared to have spread round the base of each colony to the extent of 2-3 mm. Some of the colonies had a depression in the centre. The colour of the majority of the colonies varied from white to cream. In some of the tubes that were kept at room temperature an orange yellow ring of thick growth appeared to develop around each white colony which itself, however, had maintained its white colour. The blood cultures of the "filtrate strains" thus showed a very varied colony formation.

Growth on Liquid Media.—An easy method was developed for obtaining cultures of tubercle bacilli directly from solid on to a liquid medium. As tubercle bacilli grow only on the surface of a liquid medium and not in the depth care has to be taken when planting to see that the fragment of culture transplanted floats on the surface; for if it sinks it will not grow. With dry scaly cultures such as of human tubercle bacilli, the direct transplantation from the solid to the liquid medium is comparatively easy. But such is not the case with moist and slimy cultures such as of avian bacilli. By this new method cultures of any type of tubercle bacilli, whether dry or moist or slimy can easily be transplanted directly from a solid medium on to the surface of a liquid medium on which they continue to float and grow.

Adopting this method a large number of observations were made on the alteration of the pH of the liquid medium—Sauton's medium inoculated with the different "filtrate strains". It was found that the "filtrate strains" produced a considerable amount of acidity in the medium—the original pH of 7·2 changing to 5·5 or in some cases even to 4·9. But this varied in different flasks inoculated even with the same strain and in some cases very little acidity was produced—the pH remaining at 7 or 6·8. Further

the degree of acidity could not always be correlated either to rapidity of the growth or to its luxuriance an determined by the final bacterial content of the culture.

Biological Variations.—In the course of study of the biological characters of the "filtrate strains" one of the interesting characters observed was the ability of some of the "filtrate strains" to grow in the depth of the liquid medium. It is well known that tubercle bacilli of the classical types when planted on a liquid medium grow on the surface in the form of a film or a pellicle and do not grow in the depth of the medium. Indeed, it is recommened that one should always suspect a contamination if the liquid medium becomes turbid.

A large number of "filtrate strains" from different passage animals were collected in the course of this study of the question of the existence of a filtrable virus of the tubercle bacillus. Twelve of these strains together with one each of known human, bovine, and avian strains were tested on Sauton's medium to study the relative character of growth. Periodical observations were made and the obviously contaminated flasks were discarded. Study of the remaining flasks showed that those inoculated with known classical types of human, bovine, and avian strains had, as would be expected, surface growth in the form of a pellicle which gradually became thickened and even crawled up the sides of the flask, the medium itself remaining perfectly clear.

Out of the remaining flasks, eighteen inoculated with five different "filtrate strains" showed similar surface growth with the subjacent fluid perfactly clear. But twenty other flasks inoculated with seven other "filtrate strains" showed no growth on the surface. The medium became distinctly turbid and apparently seemed to be contaminated. Subsequent examination and tests on other media, however, showed them to be pure growths of tubercle bacilli and free from extraneous contamination. Further analysis and correlation of results showed that all the five "filtrate strains" that grew on the surface of the liquid medium were non-virulent for the fowl while each of the seven "filtrate strains" that failed to grow on the surface but grew in the depth of the liquid medium and rendered it turbid were virulent for the fowl and which produced in it an acute fatal infection. Attention may again be drawn here to the fact that the three flasks inoculated with a strain of known avian bacillus which was also fully virulent for the fowl showed no turbidity but only surface growth leaving the fluid underneath perfectly clear, indicating that the "filtrate strains" although resembling the avian bacillus in their virulence for the fowl differ from it in this respect.

A second series of experiments carried out to confirm these findings gave similar results. In order to make sure that the turbidity in the liquid medium was due to growth of tubercle bacilli the liquid culture of two strains was inoculated into fowls. Three of the fowls died within 26-28 days of acute infection with numerous acidfast bacilli in the organs thus affording a further proof that turbid culture was of tubercle bacilli virulent for the fowl.

The filtration experiments have been repeated and four fresh experiments were made using for the first two experiments tissues of a guinea-pig and a rabbit respectively inoculated with a strain of tubercle bacillus isolated from a monkey showing natural infection with bovine bacilli. The other two experiments were made with tissues from guinea-pigs inoculated with cultures isolated from Sambhars from the Bombay Zoological Gardens. The experiments were somewhat modified in so far as the passage animals used included fowls in addition to guinea-pigs used previously. Eight passages were made in each of the experiments involving the use of 147 animals and birds of which 19 showed acid-fast bacilli and in two out of four experiments strains were isolated. Both of these strains were pigmented and differed in characters from the original strains used for filtration. Both were non-virulent for guinea-pigs as well as for fowl and rabbits. In several characters these strains bore close resemblance to the new chromogenic dissociated variant of avian tubercle bacilli recently described by Winn and Petroff.

The appearance of pigmented colony in the culture suggested that it might be *B.phlei.* Whether this bacillus is occasionally present in normal tissues of the fowl is not known. Attempts were therefore made to determine this by cultivation from the spleen pulp of a large number of apparently healthy fowls. Out of 61 fowls thus examined in no case was any growth obtained.

Tuberculous Bacillæmia.—In view of the interest created in the question of tuberculous bacillæmia by the work of Loewenstein and others attempts were made to test the presence of bacillæmia in experimental animals and cultures were made from the blood of fowls infected with virulent strains. Thirty-five fowls in all were inoculated with different strains of tubercle bacilli including the "filtrate strains" and blood cultures were made during life from all of them. Of the 16 fowls which on post-mortem examination later showed affection with tuberculosis, the blood culture in every case proved positive and yielded pure cultures of tubercle bacilli indicating the presence of bacillæmia. The remaining nineteen fowls gave negative blood cultures and, with a single exception, none of them on post-mortem examination showed any acid-fast bacilli in the organs. Out of seven rabbits which were inoculated with the "filtrate strains" and five of which showed chronic joint lesions, the blood culture was positive in two.

Transformation of Tubercle Bacillus of One Type into Another.—Results of considerable interest were obtained in the case of two strains. One of these had become accidentally contaminated and it was chemically treated to free it from contaminants and when a pure culture of tubercle bacillus was obtained it showed acquisition of new characters. While the original culture had shown characters of the human type, the culture obtained after treatment resembled the avian type. The morphology of the bacilli had also changed. The original uniformly stained bacilli in the previous culture had now given rise to long filamentous branching forms in the spleen of a fowl that died of acute septicæmia.

Another instance of apparent change in the biological characters was met with in the case of a strain isolated from a sambhar which had died of extensive tuberculosis in the Bombay Zoological Gardens. A direct culture isolated from this animal showed at first all characters of the bovine type. After several subcultures it was again tested on rabbits and fowls; in the rabbits it gave results resembling effects of bovine bacillus; in the fowls it proved virulent and resembled the avian bacillus. A culture isolated from this fowl when tested again on rabbits produced results resembling this time not the bovine but the avian bacillus. It is difficult to say whether the original strain was purely of the bovine type which had later changed into the avian type or that it was originally a mixture of the bovine and the avian types and the latter subsequently developed in a pure form in the tissues of the fowl and in cultures derived from it.

Spontaneous Tuberculosis in Laboratory Animals.—One instance of this occurred in one of the monkeys under experiment. This animal was originally obtained from Madras and was used for estimating the virulence of a strain which by other tests was found to be of very low virulence. The animal was inoculated with a very small dose of this strain and on autopsy it showed extensive tuberculosis of the internal organs and the strain isolated from it was found to be of the bovine type. A fellow monkey, however, inoculated at the same time with a larger dose of the same strain showed no evidence of tuberculosis. This clearly showed that the first animal was already suffering from spontaneous or natural infection at the time of the test. Although all monkeys were subjected to a preliminary tuberculin test to determine their freedom from infection this could not be detected owing to the fact that the monkey does not respond satisfactorily to the tuberculin test. On account of its great susceptibility to tuberculosis and its unsatisfactory response to the tuberculin test, the monkey, unless bred in the laboratory and kept under known conditions, would not appear to be a suitable animal for such tests.

Surgical Tuberculosis among Children in India.—Six further strains from tuberculous adenitis and tuberculous spine in children under six years of age were isolated and their characters studied. All the strains proved to be of the human type. Thus out of 158 cases examined so far, of glandular, bone and joint and other forms of non-pulmonary human tuberculosis and 90 strains isolated and studied—60 from adults and 30 from children—in two cases (both adults) the infection was found to be caused by the bovine bacillus and in one case in a child by the avian tubercle bacillus; the remaining were due to the human type.

Vernes Resorcin Test for Tuberculosis.—This test is claimed to be of value in the diagnosis and prognosis of the disease. In order to see if non-tuberculous conditions give a positive reaction the test was applied to a large number of hospital patients suffering from various conditions other than tuberculosis and in none of whom the existence of the disease was suspected. Out of 346 such sera examined with the aid of a special photometer positive results

for tuberculosis, denoted by a high index, were obtained in over 50 per cent. of cases. No relation was observed between febrile conditions and high index indicating a positive reaction, as in several of the positive cases the temperature was normal. Another group of patients examined comprised cases of pulmonary tuberculosis and of surgical tuberculosis. Out of 112 such cases, 105 or over 93 per cent. gave positive reaction. Only 7 cases gave a doubtful reaction and in six of these the sputum findings were negative. The presence or absence of fever did not appear to have any great effect upon the severity of the reaction, nor did the presence of tubercle bacilli in the sputum necessarily indicate, according to this test, activity of the disease. In no case of definite tuberculosis was a negative reaction obtained. The chief value of the test, in so far as our examination had gone, lies in the fact that a negative result contra-indicates active tuberculosis although the converse does not necessarily hold good.

The Inquiry was closed in May 1934.

A paper on "The Filtrable Phase of the Tubercle Bacillus" was published in the Indian Medical Gazette for August 1933.

A paper on "Vernes Serum Test for Tuberculosis" was read before the Medical and Veterinary Research Section of the Indian Science Congress held in Bombay in January 1934.

A contribution was submitted on the subject of "Biological Variations of the Tubercle Virus" selected for discussion before the 9th Conference of the International Union against Tuberculosis held at Warsaw (Poland) from 4th to 6th September 1934 and will be published in the Proceedings of the Conference.

C. Minor Enquiries.

(I) Nutrition.

(Gokhale & Malandkar). A Nutritional Unit has been established to carry out vitamin assay of foodstuffs, particularly fruits, vegetables and dairy products available in the Bombay Presidency.

To ascertain whether the available strain of white rats are suitable for Vitamin A and D work, experiments of a routine nature have been carried out and the deficiencies ascribable to these vitamins have been produced.

The following research has been undertaken:—

1. *Estimation of Ascorbic Acid content in the bloods of normal Indian young men.*—The subjects chosen were young college students between 20 and 30 years of age. The ascorbic acid content was estimated by the method of Mirsky, Swadesh and Soskin (Proc. Soc. Exp. *Biol. Med.*, 32, 1130, 1935). So far thirty-six bloods have been examined. The average ascorbic acid content was 1·81 mg. per cent. (range 1·21-2·54 as compared to 1·19—2·66 mg. per cent. given by the above workers).

2. *Assay of the Ascorbic Acid content of the vegetables and fruits available in the Bombay Markets.*—The ascorbic acid content was estimated according to the method described by

Bessey and King (Jour. Biol. Chem., 103, 687, 1933). So far twenty-one kinds of vegetables and fruit obtained from the markets situated in a Bombay mill area have been examined. The following table gives the results :—

Name.	Ascorbic Acid mg. per cent.	Name.	Ascorbic Acid mg. per cent.
Bhenda : Lady's Finger ...	8·8	Dudhya : white pumpkin ...	2·8
Methi leaves	103·9	Bhopala : Yellow Gourd ...	2·4
Mula (Radish) leaves ...	84·7	Dodka Gourd	3·1
Chawali leaves	3·7	Padwal : Snake Gourd ...	2·0
Takala leaves	19·9	Kohala Gourd	1·9
Shevga (drum stick) leaves...	4·1	Chillies green, whole ...	107·9
Betel Leaf	3·2	Chillies green, rind ...	142·1
Orange : Loose skin ...	33·0	Onion, white	6·7
Sweet Lime	43·5	Onion, red	6·6
Karla : bitter Gourd ...	80·8		

(II) Macrocytic Anaemia in Monkeys.

Dr. Lucy Wills continued experimental work in connection with production of macrocytic anaemia in experimental animals. The experiments were extended to monkeys (*Macacus sinicus*). Monkeys were fed on a deficiency diet consisting largely of polished rice, white bread and chapati a diet in common use among sufferers from tropical macrocytic anaemia. It was found that the monkeys on this deficiency diet regularly developed macrocytic anaemia. The anaemia resembles very closely that seen in cases of tropical macrocytic anaemia and the marrow picture is that of Megaloblastic hyperplasia. It would appear probable then that this diet is causally related to the anaemia both in animals and in man. The diet is not only relatively deficient in all the vitamins (vitamin D was supplied by exposure to sun-light), but also in proteins and salts. The addition of large doses of vitamin A and C did not protect the animals, whereas the further addition of a large dose of Marmite, a rich source of vitamin B complex, and also of good protein and salt value, brought about a rapid cure of the condition. As the Marmite is inactive in the treatment of Addison's anaemia it can be assumed that the curative factor in Marmite is not the same as the anti-anaemia factor contained in liver.

Clinical trials of various preparations containing vitamin B_1, B_2 and B_4 failed to show that any of these vitamins have haemopoietic properties in tropical macrocytic anaemias. Marmite, an autolysed yeast product is active curatively in similar cases. The haemopoietic factor in Marmite was found to be soluble in water, 8 per cent. alcohol and was heat stable.

The above work has been published. See List of Papers published from the Institute.

(III) Meningococcus.

At the request of the Director of Public Health for the Government of Bombay, Poona, Wagle and Mhaskar investigated an epidemic of Cerebro-spinal fever at Ahmedabad.

Again, at the request of the Inspector General of Prisons, Bombay Presidency, Poona, in 1934, investigation for Carriers was carried out twice in Visapur Jail.

A. Investigation of Meningococcus Carrier.—During 1934, investigations for the carrier were carried out twice in Visapur Jail, once in April and once in October. Each suspect was examined twice, with an interval of at least three days between the two examinations. Cultures were made on blood agars and from these suspected colonies were picked up and submitted for further examination. Final diagnosis was made on (i) pigment formation or otherwise, (ii) carbohydrate reactions, and (iii) agglutination with meningococcal sera. Only those cultures which agglutinated with the diagnostic sera were taken as meningococci. It was found during the course of these investigations that certain gram-negative diplococci, capable of fermenting sucrose and probably belonging to the flavus group of organisms, agglutinated with the polyvalent maningococcal therapeutic serum in low dilutions, and had reliance been placed entirely on agglutination reaction, would have passed off as meningococci. Their young colonies resembled meningococcal colonies very closely and they did not agglutinate with the normal horse serum. This showed that for final diagnosis it is necessary to take into consideration the carbohydrate reactions along with the agglutination tests, if mistakes on account of group reaction are to be avoided. In the first investigation, no carrier was found; but in the second, five carriers were detected.

B. Obervations on Cultural Characters.—When the preparation of Meningococcal Vaccine was undertaken by this Institute, elucidation of some points became necessary. The points that required elucidation were (*i*) Can meningococci be isolated from cerebrospinal fluids sent by Post from different parts of India? This means that the cerebro-spinal fluid has to remain at room temperature (i.e., 25° to 27° C.) for some hours, and in colder parts probably even at lower temperature (i.e., 18° to 20° C.) before plating; (*ii*) What medium is more suitable for primary isolation of meningococcus and what is suitable for stocking the meningococcal strains?; (*iii*) How long will the meningococcus remain alive at different temperatures on suitable media, i.e., in the refrigerator between 5° to 8° C., at room temperature, and at 37° C.

(*i*) This investigation was carried out on cerebro-spinal fluids received from Arthur Road Hospital, Bombay. As soon as the fluid was received, it was divided into two parts after thorough mixing: one part was kept at room temperature and the other in the outer cold room (18-20° C.). They were then plated on suitable media after varying intervals, i.e., after 24 hours and 48 hours, and the growth allowed to take place at 37° C. It was found that not only did meningococci remain alive for 48 hours in the

portion of the fluid kept at room temperature, but could actually multiply while so kept. Of the seven fluids kept in the outer cold room, all gave growth of meningococcus when plated after 24 hours, but only four gave growth when plated after 48 hours. It is thus evident that if meningococci are present in fair number, growth can be obtained from cerebro-spinal fluid, even if it remains at temperatures round about 18° to 20° C., for a few hours before plating and it is possible to isolate meningococcus from cerebro-spinal fluids sent by Post from different parts of India.

(*ii*) Various media have been suggested for the isolation of meningococci but those commonly recommended are blood agar and ascitic agar. Another medium that suggested itself was the heated blood agar that is used in this Institute for the growth of *B. influenzae*. For the sake of convenience this is called the influenza medium. The suitability of these three media was tested by doing comparative tests at the same time with equal quantities of cerebro-spinal fluids. It was found that influenza medium gave the most prolific growth, next in order came the blood agar, and next the ascitic agar. It has been possible to obtain growth of meningococcus from cerebro-spinal fluid on influenza agar more often than either on blood or ascitic agar. But this medium is not so suitable for stocking the strains as meningococcus does not survive long on this. For stocking, rabbit's blood agar has been found to be quite good, provided care is taken to seal the tubes with paraffin before putting them aside.

(*iii*) Regarding the most suitable temperature for stocking the meningococcal strains, the text-books recommend 37° C. The medium used for stocking the cultures was blood agar. Cultures were made on blood agars, and they were kept in the incubator at 37° C., at room temperature, and in the refrigerator between 5° and 8° C. Tubes were then taken out from these at definite intervals and subcultures made from them to test the viability of the organisms. It was found that almost all the strains, stocked at 37° C., were alive after one month, while majority of them were alive after two months. With some of the strains, growth was obtained even after three months. Of the eight strains stocked at room temperature, all were found alive when plated after six weeks. Eight strains were stocked in the refrigerator between 5° to 8° C. When plated after one week, only three of them showed growth, while when plated after fourteen days, none of them was found to be alive. It is evident from this that strains can be stocked either at 37°-C., or at room temperature, but cannot be kept in the refrigerator. Monthly subcultures seem to be sufficient if care is taken to seal the tubes properly with paraffin. Occasionally however a strain is found which for no obvious reason dies out, if more frequent sub-cultures are not made at least in the beginning and to avoid such a loss, it seems desirable to make the first two or three sub-cultures at an interval of ten days and then keep the strains going by monthly sub-cultures.

Dr. R. Row, O.B.E., M.D., D.Sc. (Lond.)—Voluntary Research Worker at the Haffkine Institute—was enabled to continue the

study of some of the problems which remained unfinished and interrupted after his relinquishing the Chair of Pathology at the Grant Medical College, Bombay. The following is the brief account of the work done :—

(IV) Leishmania Tropica Vaccine.

The application of *Leishmania tropica* vaccine elaborated in 1912 by Row for the treatment of Oriental Sore, having given him very satisfactory results in a large number of cases, a systematic and continued investigation of this subject was felt imperative to assess its value. It became necessary to obtain this vaccine in quantities required for field work. A technique has been worked out by which a fair quantity of the vaccine is now available. A preliminary trial in Persia on a very few cases having given him striking results a systematic investigation was started at Ferozpore, Punjab, where a good amount of clinical material is available. This inquiry is in progress and its results are awaited with interest.

A culture fluid adopted by Dr. Row since 1912 is the simple haemoglobin saline solution which can be prepared in a few minutes in the laboratory and in which one is able to maintain the viability of the parasites for over 110 days. In addition to the culture fluid being suited for maintaining the longevity of *Leishmania tropica* in culture and its simplicity of technique it allows minimum risk of contamination as the culture tube need not be opened except for inoculation after which it is left aside in the cold incubator till a sub-culture is indicated.

(V) Anti-Malarial Remedies.

The recent synthetic compounds (Atebrin and Plasmoquin) having attracted attention in the treatment of human malaria, it was found interesting to study the comparative value of these anti-malarial remedies in experimental malaria for which Plasmodium knowlesii in *Macacus rhesus* gave such excellent opportunity. Two monkeys (*M. rhesus*) were infected with three drops of blood from an infected animal in articulo mortis. Both the animals developed malaria. On the fifth day 0·025 gramme of Atebrin was administered orally. The dose was repeated on the four following days. In 48 hours all rings had apparently disappeared and the blood remained free from parasites for some days. Twelve days after the last dose of Atebrin both the animals showed a return of the rings when the same course of Atebrin was repeated. The rings again disappeared only to re-appear on the 16th day after the last dose of the drug. They increased in numbers and in size and the animal died on the fourth day. The second animal was given a course of 0·025 gramme of Atebrin for 15 days continuously, and when examined ten days after the last dose, was apparently free from infection. On the 13th day the blood was loaded with rings. Atebrin was again administered but failed to produce any response and the animal died.

From the above observations it may be permissible to conclude that though Atebrin in the dosage employed acts rapidly in monkey malaria causing apparently complete disappearance of asexual forms of the parasite from the peripheral blood it does not prevent the re-appearance of the parasite in its usual highly virulent state.

The fatal event in acutely infected Macacus may be prevented by the administration of the Quinine as has been observed repeatedly by all workers on the subject; a similar result is brought about by the exhibition of Atebrin as shown above. The observations were extended to study the effect of Plasmoquin and the action of all three drugs with a view to investigate (1) Course of infection, (2) Changes in the parasite, and (3) the pathological changes in the chief organs and tissues of the infected animal. It may be stated once for all that these compounds when administered during the course of acute infection, early enough, are capable of preventing the death of the animal. All the three drugs, however, fail in completely ridding the animal of the infecting parasite.

Quinine.—If in early trophozoite stage and when proportion of invaded corpuscles is below 40 per cent., quinine in 2½ grain doses is administered, rapid growth of the trophozoites is checked. The trophozoites and the host cell along with merzoites shrink and appear to be destroyed *in situ* and phagocytosed. The gametocytes now begin to appear. A quiescent state continues for a few days followed by a recrudescence of rings and tendency towards an acute attack unless prevented by similar administration of quinine as before. Ultimately a chronic state is brought about and gametocytogomy is established.

Atebrin.—The rings seem to be attacked directly, even when a small dose of 0·025 gramme is given, as they inhibit in their progress and therefore the destruction is more rapid than under quinine. Blood clears up in two days, but the ring forms reappear after about 10 days after the last dose. The same good result is obtained if Atebrin is repeated. When however this treatment is carried on for some time (2 to 3 weeks) a subsequent recrudescence is characterised by return of a large number of rings and then there is danger of losing the animal.

Plasmoquin.—The action of Plasmoquin on the asexual cycle resembles that of quinine in its slowness, but is more potent even in small doses. The secondary anaemia however is more intense than under Atebrin or Quinine, but the rings return early so that after 4 days, interval of a long course of Plasmoquin the blood shows 4 or 5 rings in each field and the animal runs risk of succumbing to the effect of a relapse.

It is observed, therefore, no matter which of these compounds is used, that there is always a return of parasites with this difference that the state of equilibrium leading to a chronic infection is brought about more effectively with fewer courses of Quinine than with the other two products. This work has been published (See "List of Papers published").

(VI) Experimental Studies on Leprosy.

In conjunction with Dr. N. P. Dalal, Row carried out experimental attempts to infect laboratory animals (white mouse and rat, guinea-pig and Macacus monkey) with leprosy virus from material obtained from human lesions. Their findings are published in the Indian Journal of Medical Research for the month of January 1934. They found that (1) Simple subcutaneous injections of human leprosy material fail to produce any obvious disease effect in white mice, rats, guinea-pigs and the Macacus monkeys, as also intraperitoneal injections, except in the case of white mice; (2) White mice develop after six weeks with a course of 4 to 6 intraperitoneal injections, difinite though minute, seed-like nodules in the gastro-splenic omentum and occasionally in the mesentery. These nodules are made up of aggregations of cells enclosed in a fibrous capsule and packed with apparently vigorous acid-fast bacilli suggesting a well marked bacillary proliferation. Mesenteric glands show definite specific granulomata, but with less pronounced bacillary invasion.

Along with this investigation, an endless series of experiments with a view to obtain culture of *B. leprae* in vitro has been undertaken and are being pursued. So far no positive results are in sight.

(VII) Spirillum Minus.

Studies on the parasite of rat-bite fever are in progress, especially with a view of obtaining the *S. minus* in culture.

(VIII) "Entoray" machine as an Anti-mosquito measure.

With the great development of shipping the possibility of introduction of Yellow Fever into India has been freely discussed in the past. The anti-mosquito measures already in use are expensive, and, under conditions pertaining in a dock area cannot guarantee elimination of all insects.

When Mr. V. Menasché—Managing Partner of the Société Nomosquito—approached the Port Health Authority for the sale of "Entoray" machines, an opportunity was taken to test the efficacy of the machine under exact experimental conditions before purchasing the machine. Mr. Menasché placed a machine at our disposal.

Experiments devised to test the efficacy of the Machine were carried out in conjunction with Lt.-Col. A. C. L. O. Bilderbeck, Port Health Officer, Bombay, from 27th September to 1st November 1935.

The machine consists of a mercury vapour lamp emitting a bluish light at the top of a hollow square pillar, down which a column of air is sucked by a powerful motor fan placed in the base

of the machine—the air passing through a wire gauze box in which all the insects attracted by the machine are trapped.

A number of experiments were carried out in which a known number of Culicine and Anopheline mosquitoes were released in close proximity to the machine (in some cases as near as 10 feet) and the machine run for a whole night (10 hours) after each release. Out of the 1,550 stained Culicines the machine caught only one during a working period of three nights (30 hours). During this period 185 unstained mosquitoes were trapped by the machine out of the local fauna. Out of the 300 Anopheles released 19 were caught in 10 hours. During a period of 20 hours about 8,000 other insects (mostly "beneficial") were caught by the machine.

It is concluded that the machine is not a practical anti-mosquito measure under the conditions of the above experiment.

(IX) Study of the Stability of Russell's viper venom solutions.

(Wats, Dalal and Gokhale)

The use of Russell's Viper Venom for stopping haemorrhage in haemophilia and in other conditions suggested an investigation into the keeping properties of solutions of this venom.

(1) *Coagulating Property.*—Solutions of the venom in saline in strengths of 1:500, 1:1,000 and 1:10,000 were made. Portions of these solutions were passed through a Seitz Filter to render them sterile and the remaining portions left unfiltered. Portions of these solutions were stored in a refrigerator (4°C. $\pm$2), and other portions stored at room temperature (24° – 29°C.) in the dark. The coagulating power of these was determined at the start and then at monthly intervals using sheep's blood method as described by Taylor and others in the Indian Journal of Medical Research, XXIII, 1935.

This work has been now going on for 3 months and our determinations show that both filtered and unfiltered solutions in a dilution 1:10,000 loses the potency after storage for 2 months while 1:500 and 1:1,000 dilutions remain fully potent after a lapse of 3 months. These solutions will be continued to be examined.

(2) *Toxic Property.*—The stability of the lethal power of the same venom solutions as stated above was determined by the method described by Anderson (Ind. Jour. Med. Res., XX, 1, 1932). It was found that venom solutions when stored in the refrigerator (4°C.$\pm$2) have retained their toxic property undiminished for a period of three months during which they have been examined, while the solutions kept at room temperature (24°—29°C.) showed a marked loss of toxicity in as short a period as one month.

Difference between the Coagulating and the Toxic Properties of the Venom.—Preliminary work on this subject shows that it is possible to reduce the toxicity of the venom without affecting its

coagulating property. Work on this point is being continued and if the preliminary observations are confirmed it would constitute a great advance in the therapeutic use of Russell's Viper venom as an haemostatic agent.

LIST OF PAPERS PUBLISHED FROM THE HAFFKINE INSTITUTE DURING THE YEARS 1932-35.

1. *Caius, J. F. & Mhaskar, K. S.*—" Notes on Indian Scorpions ". Ind. Med. Res. Memoir, No. 24, 1932.

2. *Caius, J. F. & Bharucha, K. H.*—" Earth-eating & Salt-licking in India "—Analyses XIV—XXV. Journ., Bom. Nat. Hist. Soc., XXXVI, 1, 218-24 ; 1932.

3. *Wills, Lucy & Bilimoria, H. S.*—" Production of a Macrocytic Anaemia in Monkeys by Deficient Feeding ". Journ. Ind. Med. Res., XX, 2, 391-402 ; 1932.

4. *Wills, Lucy.*—" The nature of the Haemopoietic Factor in Marmite ". Lancet (I). pp. 1283-86 ; 1933.

5. *Row, R., Dalal, N. P. & Gollerkeri, G. V.*—" On the Value of Atebrin in Monkey Malaria ". Trans. Roy. Soc. Trop. Med. & Hyg. XXVI, 5, 469-470 ; 1933.

6. *Row, R., Dalal, N. P. & Gollerkeri, G. V.*—" On the Effects of Quinine, Atebrin and Plasmoquin on Experimentally induced Malaria in the Macacus Monkey and on some of the Pathological Changes observed ". Ind. Jour. Med. Res. XXI, 2, 295-98 ; 1933.

7. *Soparkar, M. B. & Dhillon, C. S.*—" The Filtrable Phase of the Tubercle Bacillus ". Ind. Med. Gazette, LXVIII, 456-57 ; 1933.

8. *Soparkar, M. B. & Dhillon, C. S.*—" Question of the Filtrability of the Tubercle Bacillus ". Proc. Ind. Sc. Congress, Page 395 ; 1933.

9. *Greval, S. D. S. and Dalal, N. P.*—" On Bacillus Pestis : New Techniques in Serology ". Ind. Journ. Med. Res. XXI, 2, 283-94 ; 1933.

10. *Taylor, J.*—" Haffkine's Plague Vaccine". Ind. Med. Res. Memoir, No. 27 ; 1933.

11. *Soparkar, M. B. and Dhillon, C. S.*—" The Vernes Resorcin Serum Test for Tuberculosis ". Proc. Ind. Sc. Congress, p. 375 ; 1934.

12. *Soparkar, M. B. and Dhillon, C. S.*—" The Biological Variations of the Tubercle Virus ". Proc. of the Ninth Conference of International Union Against Tuberculosis, Warsaw, 1934 (in Press).

13. *Row, R., Dalal, M. P. and Gollerkeri, G. V.*—"On Some Experimental Studies on Leprosy". Ind. Journ. Med. Res., XXI, 3, 545-52; 1934.

14. *Row, R.*—"On the Longevity of *Leishmania tropica* in Culture". Bulletin de la Société de Pathologie exotique, Paris, XXVIII, 4, 269-70; 1935.

15. *Sokhey, S. S. and Maurice, H.*—"On a Biological Method of Standardisation of the Anti-plague Vaccines and the Relative Protective Power of some Anti-Plague Vaccines measured by this Method", Bulletin de l'Office Internationale d'Hygiéne publique, XXVII, 8, 1534-41; 1935.

16. *Sokhey, S. S., Wats, R. C. and Chitre, G. D.*—"Relative Potency of certain Proprietary Calcium Cyanide Preparations for Destruction of Rats and Fleas". Sent for publication to Ind. Med. Gazette.

17. *Tscherbakoff, S. G.*—"Feeding of Cobras in Captivity", Journ. Bom. Nat. Hist Soc., XXXVIII, 2, 321-29; 1935.

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15th March 1936.

PART III.

APPENDICES.

Statistics of Anti-rabic Inoculation.

(Standard Tables for use in India.)

APPENDIX I.

1932.

Statistics of Anti-rabic Inoculation.

(Standard Tables approved for use in India.)

APPENDICES.

TABLE I.

A general statement regarding patients treated at the Institute and its Centres from 1922 to 1932.

Year.	Europeans.				Asiatics.				Europeans and Asiatics combined.			
	Total treated.	Total deaths.	Total death rate per cent.	Advice cases.	Total treated.	Total deaths.	Total death rate per cent.	Advice cases.	Total treated.	Total deaths.	Total death rate per cent.	Advice cases.
1922... Institute ...	64	.....	.....	.....	365	4	1·04	175	429	4	0·89	175
1922... Centres ...	7	.....	.....	.....	236	.....	.....	.....	243	.....	.....	.....
1922... Combined ...	71	.....	.....	.....	601	4	0·66	175	672	4	0·61	175
1923... Institute ...	115	.....	.....	59	730	10	1·37	359	845	10	1·18	418
1923... Centres ...	38	.....	.....	.....	1,521	12	0·78	260	1,559	12	0·76	260
1923... Combined ...	153	.....	.....	59	2,251	22	0·97	619	2,404	22	0·91	678
1924... Institute ...	62	1	1·61	41	525	9	1·71	372	587	10	1·70	413
1924... Centres ...	85	.....	.....	.....	2,880	28	0·97	330	2,965	28	0·94	330
1924... Combined ...	147	.....	.....	41	3,405	37	1·08	702	3,552	38	1·06	743
1925... Institute ...	42	.....	.....	27	583	6	1·02	219	625	6	0·96	246
1925... Centres ...	187	.....	.....	5	3,569	28	0·78	393	3,756	28	0·78	393
1925... Combined ...	229	.....	.....	32	4,152	34	0·81	612	4,381	34	0·79	644
1926... Institute ...	60	.....	.....	51	588	5	0·87	440	648	5	0·76	491
1926... Centres ...	287	.....	.....	20	3,861	25	0·64	322	4,148	25	0·60	342
1926... Combined ...	347	.....	.....	71	4,449	30	0·67	762	4,796	30	0·60	833
1927... Institute ...	51	.....	.....	37	678	6	0·88	468	729	6	0·82	505
1927... Centres ...	303	.....	.....	31	3,857	25	0·64	490	4,160	25	0·62	521
1927... Combined ...	354	.....	.....	68	4,535	31	0·68	958	4,889	31	0·61	1,026
1928... Institute ...	39	.....	.....	40	679	6	0·88	418	718	6	0·83	458
1928... Centres ...	216	.....	.....	27	4,166	34	0·81	467	4,382	34	0·77	494
1928... Combined ...	255	.....	.....	67	4,845	40	0·82	885	5,100	40	0·78	952
1929... Institute ...	35	.....	.....	43	650	5	0·77	522	685	5	0·73	565
1929... Centres ...	286	.....	.....	19	4,621	43	0·93	507	4,907	43	0·89	526
1929... Combined ...	321	.....	.....	62	5,271	48	0·91	1,029	5,592	48	0·89	1,091
1930... Institute ...	26	.....	.....	34	710	.....	.....	401	736	.....	.....	435
1930... Centres ...	314	1	0·29	10	4,692	50	1·07	92	5,006	51	1·01	102
1930... Combined ...	340	1	0·29	44	5,402	50	0·93	493	5,742	51	0·89	537
1931... Institute ...	41	.....	.....	42	1,020	3	0·29	394	1,061	3	0·28	436
1931... Centres ...	328	.....	.....	3	5,670	40	0·70	80	5,998	40	0·66	83
1931... Combined ...	369	.....	.....	45	6,690	43	0·64	474	7,059	43	0·60	519
1932... Institute ...	40	.....	.....	52	1,207	3	0·24	457	1,247	3	0·24	509
1932... Centres ...	252	.....	.....	8	5,984	60	1·00	35	6,236	60	0·96	43
1932... Combined ...	292	.....	.....	60	7,191	63	0·87	492	7,483	63	0·84	552
Total ...	2,878	2	0·06	549	48,792	402	0·82	7,201	51,670	404	0·78	7,750

TABLE II.

A general classification of patients attending the Institute during 1932.

	Europeans.					Asiatics.				
	Class of case treated.					Class of case treated.				
	I	II	III	IV	Total.	I	II	III	IV	Total.
Number fully treated	21	5	14	...	40	26	179	1/854	2/148	3/1,207
Percentage to total	52·5	12·5	35·0	...	...	2·1	14·8	70·8	12·3	...
Total deaths	...	...	...	...	...	...	...	1	2	3
Total death rate per cent.	...	...	...	...	...	...	...	0·11	1·3	0·24
Percentage of health returns					100					97·9
Number not fully treated (presumably at risk)					2					194
Advice cases (not at risk)					52					457
Cases excluded from the statistical tables for other reasons					...					...
Total ...					54					651
Grand Total ...					94					1,858

TABLE IIa

A general classification of patients attending the Centres during 1932.

	Europeans.					Asiatics.				
	Class of case treated.					Class of case treated.				
	I	II	III	IV	Total.	I	II	III	IV	Total.
Number fully treated	148	33	69	2	252	171	3/1,624	35/3,122	22/1,067	60/5,984
Percentage to total	58·8	13·1	27·4	0·7	...	2·8	27·1	52·3	17·8	...
Total deaths	...	...	...	...	...	...	3	35	22	60
Total death rate per cent.	...	...	...	...	...	...	0·18	1·1	1·1	1·00
Percentage of health returns					90·8					76·7
Number not fully treated (presumably at risk)					7					774
Advice cases (not at risk)					8					35
Cases excluded from the statistical tables for other reasons					...					...
Total ...					15					809
Grand Total ...					267					6,793

TABLE III.

Classification of patients according to position of wounds, interposition of clothing and probability of rabies in the biting animals.

Numerators—Deaths. *Denominators*—Cases.

Institute.

A—Animal proved rabid.
B—Animal certified rabid.
C—Animal probably rabid according to history.
D—History of animal unknown.
E—Animal probably not rabid according to history.

	Europeans.							Asiatics.							Total	Death rate per cent.
	A	B	C	D	E	Total.	Death rate per cent.	A	B	C	D	E	Total.	Death rate per cent.		
Bitten on face	...	...	...	...	...	...	...	2	1	11	1/17	...	1/31	3·2	1/31	3·2
Bitten on trunk and extremities (bare skin).	7	1	3	5	...	16	...	1/43	14	129	1/654	...	2/840	0·23	2/856	0·23
Bitten on trunk and extremities (through clothing).	1	...	...	2	...	3	...	14	3	52	241	...	310	...	313	...
"Licks" on any part of the body.	17	...	4	...	...	21	...	22	3	1	...	...	26	...	47	...
Total ...	25	1	7	7	...	40	...	1/81	21	193	2/913	...	3/1,207	0·24	3/1,247	0·24
Percentage to total ...	62·5	2·5	17·5	17·5	...	...	...	6·8	1·8	15·9	75·5	...	..	...	...	...
Death rate ...	...	...	...	...	...	...	...	1·2	...	...	0·21	...	0·24	...	...	...

TABLE III-a.

Classification of patients according to position of wounds, interposition of clothing and probability of rabies in the biting animal.

Numerators—Deaths. *Denominators*—Cases.

Centres.

A—Animal proved rabid.
B—Animal certified rabid.
C—Animal probably rabid according to history.
D—History of animal unknown.
E—Animal probably not rabid according to history.

—	Europeans.							Asiatics.							Total.	Death rate per cent.
	A	B	C	D	E	Total.	Death rate per cent.	A	B	C	D	E	Total.	Death rate per cent.		
Bitten on face	...	1	1	...	...	2	...	1	2/39	18/250	35	...	20/325	6·1	20/327	6·1
Bitten on trunk and extremities (bare skin).	8	13	30	26	5	82	...	1/8	3/860	32/1,823	1,052	12	36/3,755	0·95	36/3,837	0·93
Bitten on trunk and extremities (through clothing).	1	2	8	8	4	23	...	2	1/301	3/775	648	2	4/1,728	0·23	4/1,751	0·22
"Licks" on any part of the body.	61	31	38	12	3	145	...	19	64	79	14	...	176	...	321	...
Total ...	70	47	77	46	12	252	...	1/30	6/1,264	53/2,927	1,749	14	60/5,984	1·00	60/6,236	0·96
Percentage to total ...	27·8	18·6	30·6	18·2	4·8	...	...	0·05	21·1	48·9	29·3	0·02	...	...	...	...
Percentage death rate ...	...	...	...	...	...	...	...	3·3	0·47	1·8	...	...	...	...	...	...

TABLE IV.

Age and sex distribution of patients treated at Institute

Numerator—Deaths. Institute. *Denominators*—Cases.

Age in years.	Europeans.				Asiatics.				Europeans and Asiatics combined.	
	Males.	Females.	Total.	Death rate per cent.	Males.	Females.	Total.	Death rate per cent.	Total.	Death rate per cent.
0—4 ...	1	.....	1	.....	17	20	37	.....	38	.....
5—9 ...	3	.....	3	.....	110	28	138	.....	141	.....
10—14 ...	...	2	2	.....	1/148	29	1/177	0·55	1/179	0·55
15—19 ...	1	1	2	.....	104	18	122	.....	124	.....
20—29 ...	4	9	13	.....	1/244	35	1/279	0·35	1/292	0·34
30—39 ...	4	5	9	.....	172	32	204	.....	213	.....
40—49 ...	3	3	6	.....	1/115	41	1/156	0·64	1/162	0·61
50—59 ...	...	3	3	.....	41	24	65	.....	68	.....
60—69 ...	...	.....	...	.....	19	6	25	.....	25	.....
70 and over ...	...	1	1	.....	3	1	4	.....	5	.....
Total ...	16	24	40	.....	3/973	234	3/1,207	0·24	3/1,247	0·24

TABLE IV-a.

Age and sex distribution of patients treated at Centres.

Numerator—Deaths. *Denominators*—Cases.

Centres.

Age in years.	Europeans.				Asiatics.				Europeans and Asiatics combined.	
	Males.	Females.	Total.	Death rate per cent.	Males.	Females.	Total.	Death rate per cent.	Total.	Death rate per cent.
0—4 ...	11	4	15	.....	4/235	1/92	5/327	1·5	5/342	1·4
5—9 ...	18	8	26	.....	13/884	2/262	15/1,146	1·3	15/1,172	1·2
10—14 ...	12	5	17	.....	7/729	159	7/888	0·78	7/905	0·77
15—19 ...	8	4	12	.....	2/397	71	2/468	0·42	2/480	0·41
20—29 ...	72	15	87	.....	5/999	1/197	6/1,196	0·50	6/1,283	0·46
30—39 ...	27	15	42	.....	4/764	2/186	6/950	0·63	6/992	0·60
40—49 ...	20	20	40	.....	2/392	5/166	7/558	1·2	7/598	1·1
50—59 ...	5	3	8	.....	4/196	2/106	6/302	1·9	6/310	1·9
60—69 ...	1	3	4	.....	2/80	2/41	4/121	3·3	4/125	3·2
70 and over ...	1	.....	1	.....	18	2/10	2/28	7·1	2/29	6·8
Total ...	175	77	252	.....	43/4,694	17/1,290	60/5,984	1·00	60/6,236	0·96

TABLE V.

Classification according to number and position of wounds.

Numerators = Deaths. *Denominators* = Cases.

Europeans.
Institute.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg	...	2	3	...	1	...	...	...	...	...	...	...	...	...	...	...	6	...
Trunk	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Arm	21	2	5	2	...	2	...	...	...	...	...	...	...	...	...	...	32	...
Multiple ...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	2	...
Face	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Multiple face ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	21	4	8	2	1	2	1	...	1	...	...	...	...	...	...	...	40	...
Percentage death rate. ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Separate table for Europeans and Asiatics; also for Institute and Centres:—

(V) Europeans—Institute.
(V-a) ,, —Centres.
(V-b) Asiatics —Institute.
(V-c) ,, —Centres.

TABLE No. V-a.

Classification according to number and position of wounds.

Numerators—Deaths. *Denominators*—Cases.

Europeans.

Centres.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg	...	8	13	10	2	2	1	...	...	...	...	...	...	...	...	...	36	...
Trunk	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...
Arm	145	31	18	6	8	1	...	...	1	...	...	...	1	...	...	...	211	...
Multiple ...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...
Face	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
Multiple face ...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	...
Total ...	145	41	32	16	11	3	1	1	1	...	...	...	1	...	...	...	252	...
Percentage death rate.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Separate table for Europeans and Asiatics: Also for Institute and Centres:—

(V) Europeans—Institute.
(V-a) ,, —Centres.
(V-b) Asiatics —Institute.
(V-c) ,, —Centres.

TABLE No. V-b.

Classification according to number and position of wounds.

Numerators—Deaths. *Denominators*—Cases.

Asiatics.

Institute.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg ...	...	146	421	101	1/136	1/27	28	10	7	...	1	...	...	...	...	...	2/877	0·22
Trunk ...	...	5	5	2	5	...	...	...	...	...	...	...	...	...	...	...	17	.....
Arm ...	26	63	73	37	34	6	5	5	3	2	1	1	...	...	...	...	256	.....
Multiple ...	...	...	3	1	8	2	3	2	2	...	3	1	1	...	...	...	26	.....
Face ...	...	4	9	1/4	2	2	1	...	1	...	1	...	...	...	...	...	1/24	4·16
Multiple face ...	...	...	...	...	2	2	1	1	...	...	1	...	...	...	...	...	7	.....
Total ...	26	218	511	1/145	1/187	1/39	38	18	13	2	7	2	1	...	...	...	3/1207	0·24
Percentage death rate.	...	...	...	0·68	0·53	2·5	...	...	...	...	...	...	...	...	...	...	...	.....

Separate table for Europeans and Asiatics : Also for Institute and Centres :—

(V) Europeans—Institute.
(V-a) ,, —Centres.
(V-b) Asiatics—Institute.
(V-c) ,, —Centres.

TABLE No. V-c.

Classification according to number and position of wounds.

Numerators—Deaths. *Denominators*—Cases.

Asiatics.

Centres.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg ...	...	744	3/1104	6/719	5/523	3/171	122	51	2/35	4	13	3	9	3	...	6	19/3507	0·54
Trunk ...	...	58	66	34	41	10	7	3	4	...	...	...	...	...	...	...	223	...
Arm ...	176	5/311	1/436	2/280	2/214	2/89	81	28	23	12	11	2	...	4	1	1/3	13/1671	0·77
Multiple ...	...	...	1/23	42	41	2/36	3/43	17	1/16	5	11	5	7	5	...	1/7	8/258	3·1
Face ...	...	1/48	2/62	8/49	3/37	2/16	4	5	1	...	2	...	1	...	...	1	16/226	7·08
Multiple face ...	...	...	1/9	1/20	24	8	8	1/9	5	1/4	1	3	4	...	...	4	4/99	4·09
Total ...	176	6/1161	8/1700	17/1144	10/880	9/330	3/265	1/113	3/84	1/25	38	13	21	12	1	2/21	60/5984	1·00
Percentage death rate.	...	0·51	0·47	1·4	1·1	2·7	1·1	0·88	3·5	4·0	...	...	...	...	...	9·5	...	...

Separate table for Europeans and Asiatics : Also for Institute and Centres.

(V) Europeans—Institute.
(Va) ,, —Centres.
(Vb) Asiatics—Institute.
(Vc) ,, —Centres.

TABLE No. VI.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Institute.

Deep Bare.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
+ +	...	1	3	1	...	2	1	...	1	...	...	...	...	...	...	...	9	*Nil.*
+ —	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2	,,
— +	21	3	3	1	...	...	...	...	...	...	...	...	...	...	...	...	28	,,
— —	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	,,
Total ...	21	4	8	2	1	2	1	...	1	...	...	...	...	...	...	...	40	,,
Percentage death rate.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	,,

TABLE VI-a.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Centres.

Deep Bare.	Number of wounds.																Total.	Percentage death rate
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over		
+ +	...	11	14	8	7	2	...	1	...	...	...	...	1	...	...	...	44	...
+ —	...	1	5	4	1	1	1	...	...	...	...	...	...	...	...	...	13	...
— +	145	22	12	3	3	...	...	...	...	...	...	...	...	...	...	...	185	...
— —	...	7	1	1	..	...	...	...	1	...	...	...	...	...	...	...	10	...
Total ...	145	41	32	16	11	3	1	1	1	...	...	...	1	...	...	...	252	...
Percentage death rate. ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VI-b.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. Asiatics. *Denominators*—Cases.

Institute.

Deep Bare.	Number of wounds.																Total	Percentage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over		
+ +	...	131	318	1/91	1/123	1/33	29	13	11	2	7	2	1	...	...	...	3/761	0·39
+ —	...	30	89	26	43	5	7	5	2	...	...	...	...	...	...	...	207	...
— +	26	32	51	16	9	1	1	...	...	...	...	...	...	...	...	...	136	...
— —	...	25	53	12	12	...	1	...	...	...	...	...	...	...	...	...	103	...
Total ...	26	218	511	1/145	1/187	1/39	38	18	13	2	7	2	1	...	...	...	3/1207	0·24
Percentage death rate.	...	...	...	0·68	0·53	2·5	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VI-c.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. Asiatics. *Denominators*—Cases.

Centres.

Deep Baro.	Number of wounds.															Total	Percentage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over		
+ +	...	5/423	8/776	13/625	9/577	7/195	3/153	1/65	3/58	1/17	24	8	15	9	...	2/19	52/2894	1·7
+ —	...	146	324	1/207	188	70	57	29	9	4	7	3	5	2	1	2	1/1054	0·09
— +	176	1/375	377	2/191	1/106	1/42	33	19	12	1	2	...	1	1	...	...	5/1329	0·37
— —	...	217	223	1/121	79	1/23	22	7	5	3	5	2	...	...	...	...	2/707	0·28
Total...	176	6/1161	8/1700	17/1144	10/880	9/330	3/265	1/113	3/84	1/25	38	13	21	12	1	2/21	60/5984	1·00
Percentage death rate.	...	0·51	0·47	1·4	1·1	2·7	1·1	0·88	3·5	4·0	...	...	...	...	...	9·5	...	...

TABLE VII.

Classification according to number of wounds and lateness of arrival.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Institute.

Days late.	Number of wounds.																Total.	Percentage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over		
0 ...	1	...	1	1	...	...	1	...	1	...	...	...	...	...	...	...	5	...
1 ...	...	2	4	1	1	1	...	...	...	...	...	...	...	...	...	...	9	...
2 ...	6	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	8	...
3 ...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...
4 ...	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...
5 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
6 ...	3	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	5	...
7 ...	2	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...
8 to 14 ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
15 to 21 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
22 to 28 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29 to 35 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36 to 42 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50 and over...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	21	4	8	2	1	2	1	...	1	...	...	...	...	...	...	...	40	...
Percentage death rate. ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VII-a.

Classification according to number of wounds and lateness of arrival.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Centres.

Days late.	Number of wounds.																Total.	Percentage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over		
0 ...	11	9	7	2	4	...	...	...	...	...	...	...	1	...	...	...	28	...
1 ...	19	8	4	4	2	1	...	...	1	...	...	...	...	...	...	...	39	...
2 ...	13	6	8	1	1	1	...	1	...	...	...	...	...	...	...	...	31	...
3 ...	18	6	2	3	1	1	1	...	...	...	...	...	...	...	...	...	32	...
4 ...	18	3	5	3	...	...	...	...	...	...	...	...	...	...	...	...	29	...
5 ...	9	2	1	2	1	...	...	...	...	...	...	...	...	...	...	...	15	...
6 ...	4	4	1	...	...	...	...	...	...	...	...	...	...	...	...	...	9	...
7 ...	10	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	11	...
8 to 14 ...	31	5	2	1	2	...	...	...	...	...	...	...	...	...	...	...	41	...
15 to 21 ...	9	4	1	...	...	...	...	...	...	...	...	...	...	...	...	...	14	...
22 to 28 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29 to 35 ...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...
36 to 42 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50 and over ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	145	41	32	16	11	3	1	1	1	...	...	...	1	...	...	...	252	...
Percentage death rate.	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...

TABLE VII-b.

Classification according to number of wounds and lateness of arrival.

Numerators=Deaths. Asiatics. *Denominators*=Cases.

Institute.

Days late.	Number of wounds.																Total.	Per-centage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.		
0 ...	...	35	96	31	1/54	7	10	7	1	1	1	1	...	...	...	...	1/247	0·40
1 ...	...	77	213	1/71	72	17	13	5	6	...	4	1	...	...	...	...	1/479	0·20
2 ...	12	17	59	16	17	1	2	1	1	1	...	...	...	...	...	...	127	...
3 ...	1	16	22	8	9	3	1	1	1	...	...	...	1	...	...	...	63	...
4 ...	5	16	35	7	12	3	2	...	...	...	1	...	...	...	...	...	81	...
5 ...	5	9	18	2	5	4	3	1	1	...	...	...	...	...	...	...	43	...
6 ...	...	10	9	3	2	...	...	...	...	...	...	...	...	...	...	...	24	...
7 ...	3	4	7	2	...	...	1	...	...	...	...	...	...	...	...	...	17	...
8 to 14 ...	...	15	25	1	9	1	2	...	...	...	1	...	...	...	...	...	54	...
15 to 21 ...	...	9	9	1	3	1/2	1	1	...	...	...	...	...	...	...	...	1/26	3·8
22 to 28 ...	...	5	9	...	2	1	1	...	...	...	...	...	...	...	...	...	18	...
29 to 35 ...	...	4	3	2	2	...	1	1	...	...	...	...	...	...	...	...	13	...
36 to 42 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43 to 49 ...	...	1	4	...	...	...	1	...	...	...	...	...	...	...	...	...	6	...
50 and over ...	...	...	2	1	...	...	...	1	...	...	...	...	...	...	...	...	4	...
Total ...	26	218	511	1/145	1/187	1/39	38	18	13	2	7	2	1	...	...	...	3/1207	0·24
Percentage death rate. ...	...	...	...	0·68	0·53	2·5	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VII-c.

Classification according to number of wounds and lateness of arrival.

Numerators=Deaths. Asiatics. *Denominators*=Cases.

Centres.

Days late.	Number of wounds.																Total.	Percentage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.		
0 ...	5	33	27	1/29	1/22	8	8	2	3	2	...	3	3	...	...	...	2/145	1·3
1 ...	23	172	2/254	3/165	1/144	3/54	1/40	21	16	7	13	1	5	3	...	7	10/925	1·03
2 ...	28	1/176	1/317	2/196	2/150	1/64	52	1/19	1/13	4	7	1	3	1	...	1/6	10/1037	0·96
3 ...	44	229	313	2/210	2/152	2/59	2/51	27	2/19	1/4	8	5	...	2	...	1/5	12/1128	1·06
4 ...	21	2/153	3/222	2/180	1/136	47	45	15	12	1	1	...	4	3	...	2	8/842	0·95
5 ...	9	1/81	126	3/92	2/69	1/30	14	8	4	1	2	...	1	1	...	1	7/439	1·6
6 ...	7	57	91	60	37	16	20	6	2	3	5	1	1	1	...	...	307	...
7 ...	4	47	1/73	1/41	23	10	6	3	4	...	...	1	...	...	...	...	2/212	0·94
8 to 14 ...	24	2/128	172	3/114	1/97	1/31	20	7	9	2	1	1	4	1	...	...	7/611	1·1
15 to 21 ...	4	42	1/54	22	22	4	6	2	...	1	...	...	...	...	1	...	1/158	0·63
22 to 28 ...	...	10	12	7	6	2	...	...	...	...	...	...	...	...	...	...	37	...
29 to 35 ...	3	13	13	12	10	1/4	...	2	...	...	...	...	...	...	...	...	1/57	1·7
36 to 42 ...	...	3	1	1	...	...	...	...	...	...	...	...	...	...	...	...	5	...
43 to 49 ...	...	4	4	5	2	1	2	...	1	...	..	...	...	...	...	...	19	...
50 and over ...	4	13	21	10	10	...	1	1	1	...	1	...	...	...	...	...	62	...
Total ...	176	6/1161	8/1700	17/1144	10/880	9/330	3/265	1/113	3/84	1/25	38	13	21	12	1	2/21	60/5984	1·00
Percentage death rate.	...	0·51	0·47	1·4	1·1	2·7	1·1	0·88	3·5	4·0	...	...	...	...	...	9·5	...	...

TABLE VIII.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators = Deaths. Europeans. *Denominators* = Cases.

Institute.

Deep	Bare.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
+	+ ...	1	...	6	2	...	...	9	...
+	— ...	2	...	...	...	...	...	2	...
—	+ ...	2	...	26	...	...	...	28	...
—	— ...	1	...	...	...	...	...	1	...
Total ...		6	...	32	2	...	...	40	...
Percentage death rate.		...	...	...	...	...	...	...	...

TABLE VIII-a.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators = Deaths. Europeans. *Denominators* = Cases.

Centres.

Deep	Bare.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
+	+ ...	14	...	27	1	1	1	44	...
+	— ...	10	1	2	...	...	...	13	...
—	+ ...	7	...	178	...	...	..	185	..
—	— ...	5	1	4	...	...	...	10	...
Total ...		36	2	211	1	1	1	252	...
Percentage death rate.		...	...	...	...	...	...	...	...

TABLE VIII-b.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators—Deaths. Asiatics. *Denominators*—Cases.

Institute.

Deep Bare.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
+ + ...	2/542	3	168	21	1/20	7	3/761	0·39
+ − ...	182	7	16	2	...	...	207	...
− + ...	63	...	66	3	4	...	136	..
− − ...	90	7	6	...	...	...	103	...
Total ...	2/877	17	256	26	1/24	7	3/1,207	0·24
Percentage death rate.	0·22	...	...	...	4·1	...	...	...

TABLE VIII-c.

Classification according to position and depth of wounds, and interpositon of clothing.

Numerators—Deaths. Asiatics. *Denominators*—Cases.

Centres.

Deep Bare.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Precentage death rate.
+ + ...	15/1,552	57	12/853	6/165	15/188	4/79	52/2,894	1·7
+ − ...	1/731	75	195	41	8	4	1/1,054	0·09
− + ...	2/694	25	1/531	1/36	1/29	14	5/1,329	0·37
− − ...	1/530	66	92	1/16	1	2	2/707	0·28
Total ...	19/3,507	223	13/1,671	8/258	16/226	4/99	60/5,984	1·00
Percentage death rate.	0·54	...	0·77	3·1	7·08	4·09	...	...

TABLE IX.

Classification according to position of wounds and lateness of arrival.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Institute.

Days late.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
0 ...	...	...	3	2	...	...	5	...
1 ...	4	...	5	...	...	...	9	...
2 ...	...	...	8	...	...	...	8	...
3 ...	...	...	3	...	...	...	3	...
4 ...	...	...	5	...	...	...	5	...
5 ...	...	...	...	...	...	...	...	...
6 ...	1	...	4	...	...	...	5	...
7 ...	1	...	3	...	...	...	4	...
8 to 14 ...	...	...	1	...	...	...	1	...
15 to 21 ...	...	...	...	...	...	...	...	...
22 to 28 ...	...	...	...	...	...	...	...	...
29 to 35 ...	...	...	...	...	...	...	...	...
36 to 42 ...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	...	...	...	...	...	...
50 and over ...	...	...	...	...	...	...	...	...
Total ...	6	...	32	2	...	...	40	...
Percentage death rate. ...	...	...	...	...	...	...	...	...

TABLE IX-a.

Classification according to position of wounds and lateness of arrival.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Centres.

Days late.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
0 ...	2	1	25	...	...	...	28	...
1 ...	6	...	32	...	...	1	39	...
2 ...	5	...	25	1	...	...	31	...
3 ...	7	...	25	...	...	...	32	...
4 ...	6	...	22	...	1	...	29	...
5 ...	3	...	12	...	...	...	15	...
6 ...	...	1	8	...	...	...	9	...
7 ...	1	...	10	...	...	...	11	...
8 to 14 ...	2	...	39	...	...	...	41	...
15 to 21 ...	4	...	10	...	...	...	14	...
22 to 28 ...	...	...	...	...	...	...	...	...
29 to 35 ...	...	...	3	...	...	...	3	...
36 to 42 ...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	...	...	...	...	...	...
50 and over ...	...	...	...	...	...	...	...	...
Total ...	36	2	211	1	1	1	252	...
Percentage death rate.	...	...	...	...	...	...	...	...

TABLE IX-b.

Classification according to position of wounds and lateness of arrival.

Numerators = Deaths. *Denominators* = Cases.

Asiatics.

Institute.

Days late.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
0 ...	1/185	4	37	8	11	2	1/247	0·40
1 ...	353	8	92	13	1/8	5	1/479	0·20
2 ...	80	...	45	1	1	...	127	...
3 ...	42	3	16	1	1	...	63	...
4 ...	55	...	24	1	1	...	81	...
5 ...	30	1	16	1	...	...	48	...
6 ...	18	...	5	...	1	...	24	...
7 ...	11	...	6	...	...	...	17	...
8 to 14 ...	47	1	6	...	...	...	54	...
15 to 21 ...	1/22	...	3	...	1	...	1/26	3·8
22 to 28 ...	15	...	3	...	...	...	18	...
29 to 35 ...	10	...	2	1	...	...	13	...
36 to 42 ...	...	...	...	...	...	...	...	...
43 to 49 ...	6	...	...	...	...	...	6	...
50 and over ...	3	...	1	...	...	...	4	...
Total ...	2/877	17	256	26	1/24	7	3/1207	0·24
Percentage death rate.	0·22	...	...	...	4·1	...	...	...

TABLE IX-c.

Classification according to position of wounds and lateness of arrival.

Numerators = Deaths. *Denominators* = Cases.

Asiatics.

Centres.

Days late.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
0 ...	84	3	1/43	5	1/6	4	2/145	1·3
1 ...	2/533	33	1/240	1/47	6/49	23	10/925	1·08
2 ...	3/627	34	2/274	1/48	2/34	2/20	10/1037	0·96
3 ...	2/630	48	3/334	4/52	2/41	1/23	12/1128	1·06
4 ...	4/478	39	2/238	41	1/35	1/11	8/842	0·95
5 ...	5/276	17	1/115	1/13	15	3	7/439	1·6
6 ...	180	14	88	13	8	4	307	...
7 ...	118	9	86	4	2/13	2	2/212	0·94
8 to 14 ...	2/356	18	3/190	24	2/15	8	7/611	1·1
15 to 21 ...	100	5	45	1/4	3	1	1/158	0·63
22 to 28 ...	28	...	7	2	...	...	37	...
29 to 35 ...	1/35	1	15	3	3	...	1/57	1·7
36 to 42 ...	5	...	...	...	...	...	5	...
43 to 49 ...	16	...	2	1	...	...	19	...
50 and over ...	41	2	14	1	4	...	62	...
Total ...	19/3507	223	13/1671	8/258	16/226	4/99	60/5984	1·00
Percentage death rate.	0·54	...	0·77	3·1	7·08	4·09	...	...

TABLE X.

Deaths from Hydrophobia amongst persons treated in

Europeans.

Institute.

Serial Number.	Case Number.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and position of wounds.					Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.	
					Kind.	Class.	Leg.	Trunk.	Arm.	Face.	Total.	Deep.	Extensive.	Bare skin.	Uncauterised.					Type.	Duration in days.
←									*Nil*												→

TABLE X-a.

Deaths from Hydrophobia amongst persons treated in

Europeans.

Centres.

Serial Number.	Case Number.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and position of wounds.					Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.	
					Kind.	Class.	Leg.	Trunk.	Arm.	Face.	Total.	Deep.	Extensive.	Bare skin.	Uncauterised.					Type.	Duration in days.
←									*Nil*												→

TABLE X-b.

Deaths from Hydrophobia amongst persons treated in

Asiatics.

Institute.

Serial Number.	Case Number.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and position of wounds.					Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.	
					Kind.	Class.	Leg.	Trunk.	Arm.	Face.	Total.	Deep.	Extensive.	Bare skin.	Uncauterised.					Type.	Duration in days.
1	1588	15	M.	45	Dog ...	D	5	...	...	...	5	+	−	+	+	15	1	31	III	5 % &c.	14 days.
2	774	26	M.	25	Dog ...	D	...	...	...	3	3	+	−	+	+	1	1	28	IV	„ „	„ „
3	688	42	M.	13	Dog ...	A	4	...	...	...	4	+	+	+	+	0	3	45	IV	„ „	„ „

TABLE X-c.

TABLE

Deaths from Hydrophobia amongst

Asia

Cen

Serial No.	Case No.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and of wo		
					Kind.	Class.	Leg.	Trunk.	Arm.
									Died during
1	130	2	M.	12	Dog ...	C	...	...	3
2	105	3	F.	20	Do. ...	C	..	...	...
3	165	10	M.	12	Do. ...	C	...	...	3
4	279	13	M.	14	Jackal ...	C	...	...	...
								Died within 15 days	
1	928	12	F.	40	Dog ...	C	3	...	3
2	215	14	M.	10	Do. ...	C	...	...	3
3	118	16	F.	45	Jackal ...	C	..	...	...
4	575	16	F.	40	Dog ...	C	...	...	...
5	237	17	M.	13	Do. ...	C	2	...	...
6	626	18	M.	7	Do. ...	C	1	...	...
7	715	18	M.	8	Jackal ...	C	...	...	...
8	411	18	M.	18	Dog ...	C	5	...	...
9	301	19	M.	7	Do. ...	C	4	...	...
10	211	19	F.	2	Do. ...	C	...	...	...
11	38	19	M.	6	Do. ...	C	...	1	1
12	257	20	M.	5	Do. ...	C	...	...	3
13	20	21	F.	35	Do. ...	C	...	...	...
14	171	22	M.	45	Jackal ...	C	...	...	...
15	309	22	M.	5	Dog ...	C	2	...	...
16	337	22	M.	35	Do. ...	C	4	...	...
17	31	22	M.	35	Do. ...	C	3	...	...
18	659	23	M.	3	Do. ...	C	...	...	...
19	62	23	F.	50	Do. ...	B	11	...	8
20	131	23	F.	9	Do. ...	A	...	...	1
21	179	23	M.	6	Do. ...	C	...	...	...
22	448	24	M.	10	Do. ...	C	...	...	4
23	3	24	M.	20	Do. ...	C	...	...	1
24	27	24	M.	12	Do. ...	C	...	3	2
25	67	24	M.	60	Do. ...	C	...	...	...
26	61	28	M.	27	Do. ...	C	4	...	...

X-o.

persons treated in 1932.

tics.

tres.

position unds.		Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.		
Face.	Total.	Deep.	Extensive.	Bare skin.	Uncauterised.					Type.	Duration in days.	
treatment.												
...	3	+	—	+	+	17	1	20	III	5 cc.	5 %	2
2	2	+	—	+	+	30	1	34	IV	,,	,,	2
...	3	+	—	+	+	25	2	37	IV	,,	,,	11
2	2	+	—	+	—	4	2	19	IV	,,	,,	12
after treatment.												
1	7	+	—	+	+	2	1	15	IV	5 cc.	5 %	14
...	3	+	—	+	+	12	3	29	III	,,	,,	14
4	4	+	—	+	+	1	2	19	IV	,,	,,	14
2	2	+	—	+	+	7	2	25	IV	,,	,,	14
...	2	+	+	+	+	4	2	21	III	,,	,,	14
1	2	+	—	+	+	4	2	24	IV	,,	,,	14
3	3	+	—	+	+	10	4	32	IV	,,	,,	14
...	5	+	—	+	+	1	1	20	III	,,	,,	14
...	4	+	—	+	+	2	2	23	III	,,	,,	14
4	4	+	—	+	+	2	3	24	IV	,,	,,	14
...	2	+	—	+	+	21	1	41	III	,,	,,	14
...	3	+	—	+	+	9	1	30	III	,,	,,	14
3	3	+	—	+	+	1	2	24	IV	,,	,,	14
3	3	+	—	+	+	4	2	28	IV	,,	,,	14
1	3	+	—	+	+	2	2	26	IV	,,	,,	14
...	4	+	—	+	+	5	2	29	III	,,	,,	14
...	3	+	—	—	—	5	3	30	III	,,	,,	14
3	3	+	—	+	+	3	2	28	IV	,,	,,	14
...	10	+	—	+	+	2	1	26	III	,,	,,	14
...	1	+	—	+	+	4	2	29	III	,,	,,	14
3	3	+	—	+	+	10	4	32	IV	,,	,,	14
...	4	+	—	+	—	3	2	29	III	,,	,,	14
...	1	+	—	+	+	5	2	31	III	,,	,,	14
...	5	—	—	+	—	6	2	32	III	,,	,,	14
1	1	+	—	+	—	10	1	35	IV	,,	,,	14
...	4	—	—	+	+	4	2	34	III	,,	,,	14

TABLE

Serial No.	Case No.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and of wo		
					Kind.	Class.	Leg.	Trunk.	Arm.
							Died after 15 days		
1	258	24	F.	40	Jackal ...	C	3	...	...
2	67	29	F.	30	Dog ...	C	2	...	4
3	540	29	M.	35	Do. ...	C	...	...	...
4	50	30	M.	9	Do. ...	C	2	...	...
5	184	30	F.	25	Do. ...	C	...	...	1
6	68	31	F.	75	Do. ...	C	2	...	6
7	9	33	M.	25	Do. ...	C	...	...	1
8	93	33	F.	60	Do. ...	C	...	...	7
9	127	34	M.	5	Do. ...	C	3	...	...
10	1	35	F.	60	Jackal ...	C	...	...	2
11	67	37	M.	50	Dog ...	C	8	...	...
12	116	39	M.	25	Do. ...	C	4	...	...
13	12	41	M.	35	Do. ...	C	2	...	4
14	110	45	M.	8	Do. ...	C	...	...	...
15	49	45	M.	12	Do. ...	C	...	...	...
16	975	46	M.	50	Jackal ...	C	3	...	...
17	256	47	M.	5	Dog ...	B	...	...	...
18	4	49	M.	7	Do. ...	C	5	...	...
19	332	55	M.	12	Do. ...	B	8	...	...
20	92	59	F.	55	Do. ...	C	4	...	...
21	308	59	M.	8	Do. ...	C	...	...	...
22	883	59	M.	20	Do. ...	B	3	...	...
23	1096	59	M.	46	Do. ...	C	2	...	...
24	106	63	M.	7	Do. ...	C	...	...	1
25	719	68	M.	4	Do. ...	B	...	...	...
26	33	72	F.	40	Jackal ...	C	...	...	18
27	229	73	M.	4	Dog ...	C	3	...	...
28	182	73	M.	13	Do. ...	C	5	...	...
29	819	76	M.	60	Jackal ...	C	4	...	1
30	456	76	M.	54	Dog ...	B	...	...	5
31	302	86	F.	75	Do. ...	C	...	...	4
32	39	103	F.	5	Do. ...	C	...	...	...
33	175	121	M.	15	Do. ...	C	...	...	5
34	51	161	M.	50	Do. ...	C	3	...	3

X-c—*contd.*

position unds.		Wounds.								Treatment.	
Fuco.	Total.	Deep.	Extensive.	Bare skin.	Uncauterised.	Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Type.	Duration in days.
after	*treatmen t.*										
...	3	+	—	+	+	5	6	35	III	5 cc.	5 % 14
...	6	+	—	—	—	3	3	33	III	,,	,, 14
3	3	+	—	+	+	1	1	31	IV	,,	,, 14
...	2	+	—	+	+	2	2	34	III	,,	,, 14
...	1	+	—	+	+	8	8	41	III	,,	,, 14
...	8	+	—	—	+	3	2	36	III	,,	,, 14
...	1	+	—	+	+	2	3	38	III	,,	,, 14
2	9	+	—	+	—	3	1	37	IV	,,	,, 14
...	3	—	—	+	+	5	2	41	II	,,	2 % 14
...	2	+	—	+	+	1	2	38	III	,,	5 % 14
...	8	+	—	+	+	3	2	42	III	,,	,, 14
...	4	+	—	+	+	4	2	45	III	,,	,, 14
...	6	+	—	+	+	1	3	45	III	,,	,, 14
5	5	+	+	+	+	1	1	47	IV	,,	,, 14
4	4	+	—	+	+	3	1	49	IV	,,	,, 14
...	3	+	—	+	+	1	2	49	III	,,	,, 14
2	2	+	—	+	—	1	2	50	IV	,,	,, 14
...	5	+	—	+	+	8	1	58	III	,,	,, 14
...	8	+	—	+	—	2	2	59	III	,,	,, 14
...	4	+	+	+	+	9	2	70	III	,,	,, 14
5	5	+	—	+	+	1	2	62	IV	,,	,, 14
...	3	—	—	—	+	3	2	64	II	,,	2 % 14
...	2	+	—	+	+	4	2	65	III	,,	5 % 14
...	1	—	—	+	+	4	1	68	III	,,	,, 14
3	3	—	—	—	—	2	1	71	IV	,,	,, 14
...	18	+	+	+	+	3	2	77	IV	,,	,, 14
...	3	+	—	+	—	4	4	81	III	,,	,, 14
...	5	+	—	+	+	30	3	106	III	,,	,, 14
...	5	—	—	—	+	3	1	80	II	,,	2 % 14
...	5	+	—	+	+	2	1	79	III	,,	5 % 14
...	4	+	—	+	—	0	2	88	III	,,	,, 14
3	3	+	—	+	+	0	1	104	IV	,,	,, 14
...	5	+	—	+	+	3	2	126	III	,,	,, 14
...	6	+	—	+	—	3	2	166	IV	,,	,, 14

TABLE

Classification of the animal which bit,

Numerators = Deaths.

Animal.	Institute.								
	Number treated.			Percentage to total.			Death rate per cent.		
	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.
Dog ...	37	3/1,160	3/1,197	92·5	96·1	95·9	...	0·25	0·25
Jackal ...	...	1	1	...	...	...	...	...	...
Cat ...	2	30	32	5·0	2·4	2·5	...	...	...
Monkey ...	1	6	7	2·5	0·49	0·56	...	...	...
Fox ...	...	2	2	...	0·16	0·16	...	...	...
Man ...	...	6	6	...	0·49	0·48	...	...	...
Donkey ...	...	.....	.....	...	...	...	...	...	...
Horse ...	...	.....	.....	...	...	...	...	...	...
Buffalo ...	...	.....	.....	...	...	...	...	...	...
Hyena ...	...	.....	.....	...	...	...	...	...	...
Bear ...	...	.....	.....	...	...	...	...	...	...
Wolf ...	...	.....	.....	...	...	...	...	...	...
Bullock ...	...	.....	.....	...	...	...	...	...	...
Calf ...	...	.....	.....	...	...	...	...	...	...
Mongoose ...	...	1	1	...	...	...	...	...	...
Pig ...	...	.....	.....	...	...	...	...	...	...
Unknown ...	...	1	1	...	...	...	...	...	...
Total ...	40	3/1,207	3/1,247	...	...	...	...	...	...

XI.

scratched or licked the patient.

Denominators = Cases.

Centres.								
Number treated.			Percentage to total.			Death rate per cent.		
Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.
248	52/5,366	52/5,614	98·4	89·6	90·02	...	0·97	0·92
...	8/544	8/544	...	9·09	8·7	...	1·4	1·4
...	8	8	...	0·1	0·1	...	...	...
3	6	9	1·2	0·1	0·09	...	...	...
...	3	3	...	0·05	0·04	...	...	...
1	16	17	0·4	0·2	0·2	...	...	...
...	16	16	...	0·2	0·2	...	...	...
...	14	14	...	0·2	0·2	...	...	...
...	2	2	..	0·03	0·02	...	...	...
...	1	1	...	.....	.....	...	...	...
...	1	1	...	.....	.....	...	...	...
...	1	1	...	.....	.....	...	...	...
...	1	1	...	.....	.....	...	...	...
...	2	2	...	0·03	0·02	...	...	...
...	.....	.....	...	.....	.....	...	...	...
...	1	1	...	.....	.....	...	...	...
...	2	2	...	0·03	0·02	...	...	...
252	60/5,984	60/6,236	...	.....	.....	...	...	...

TABLE XII.

Number of patients treated by months.

	Institute.			Centres.			Institute and Centres combined.		
	Europeans.	Asiatics.	Total.	Europeans.	Asiatics.	Total.	Europeans.	Asiatics.	Total.
January ...	6	105	111	59	504	563	65	609	674
February ...	...	75	75	20	529	549	20	604	624
March ...	1	90	91	23	495	518	24	585	609
April ...	...	84	84	43	521	564	43	605	648
May ...	2	83	85	21	515	536	23	598	621
June ...	...	61	61	8	459	467	8	520	528
July ...	2	82	84	11	481	492	13	563	576
August ...	8	117	125	10	484	494	18	601	619
September ...	...	107	107	8	454	462	8	561	569
October ...	9	119	128	14	591	505	23	610	633
November ...	4	147	151	21	508	529	25	655	680
December. ...	8	137	145	14	543	557	22	680	702
Total ...	40	1,207	1,247	252	5,984	6,236	292	7,191	7,483

TABLE No. XIII.

Statement showing brains submitted and examined for rabies.

Serial No.	Animal.	Number of brains examined.	Positive.	Negative.	Unfit for examination.
1	Dog	184	152	25	7
2	Bullock	1	1	...	...
3	Cat	6	3	3	...
4	Cow	1	...	1	...
5	Donkey	1	...	1	...
6	Guinea-pig	1	...	1	...
7	Horse	1	...	1	...
8	Man	2	1	1	...
9	Jackal	2	1	...	1
10	Rabbit	2	1	1	...
	Total ...	201	159	34	8

APPENDIX II.

1933.

STATISTICS OF ANTI-RABIC INOCULATION.

(Standard Tables approved for use in India.)

TABLE I.

A general statement regarding patients treated at the Institute and its Centres from 1922 to 1933.

Year.		Europeans.				Asiatics.				Europeans and Asiatics combined.			
		Total treated.	Total deaths.	Total death rate per cent.	Advice cases.	Total treated.	Total deaths.	Total death rate per cent.	Advice cases.	Total treated.	Total deaths.	Total death rate per cent.	Advice cases.
1922	Institute ...	64	.....	.....	.....	365	4	1·04	175	429	4	0·89	175
	Centres ...	7	.....	.....	.....	236	.....	.....	.....	243	.....	.....	.....
	Combined ...	71	.....	.....	.....	601	4	0·66	175	672	4	0·61	175
1923	Institute ...	115	.....	.....	59	730	10	1·37	359	845	10	1·18	418
	Centres ...	38	.....	.....	.....	1,521	12	0·78	261	1,559	12	0·76	260
	Combined ...	153	.....	.....	59	2,251	22	0·97	619	2,404	22	0·91	678
1924	Institute ...	62	1	1·61	41	525	9	1·71	372	587	10	1·70	413
	Centres ...	85	.....	.....	.....	2,880	28	0·97	330	2,965	28	0·94	330
	Combined ...	147	1	0·68	41	3,405	37	1·08	702	3,552	38	1·06	743
1925	Institute ...	42	.....	.....	27	583	6	1·02	219	625	6	0·96	246
	Centres ...	187	.....	.....	5	3,569	28	0·78	393	3,756	28	0·78	398
	Combined ...	229	.....	.....	32	4,152	34	0·81	612	4,381	34	0·79	644
1926	Institute ...	60	.....	.....	51	588	5	0·87	440	648	5	0·76	491
	Centres ...	287	.....	.....	20	3,861	25	0·64	322	4,148	25	0·60	342
	Combined ...	347	.....	.....	71	4,449	30	0·67	762	4,796	30	0·63	833
1927	Institute ...	51	.....	.....	37	678	6	0·88	468	729	6	0·82	505
	Centres ...	303	.....	.....	31	3,857	25	0·64	490	4,160	25	0·62	521
	Combined ...	354	.....	.....	68	4,535	31	0·68	958	4,889	31	0·61	1,026
1928	Institute ...	39	.....	.....	40	679	6	0·88	418	718	6	0·83	458
	Centres ...	216	.....	.....	27	4,166	34	0·81	467	4,382	34	0·77	494
	Combined ...	255	.....	.....	67	4,845	40	0·82	885	5,100	40	0·78	952
1929	Institute ...	35	.....	.....	43	650	5	0·77	522	685	5	0·73	565
	Centres ...	286	.....	.....	19	4,621	43	0·93	507	4,907	43	0·89	525
	Combined ...	321	.....	.....	62	5,271	48	0·91	1,029	5,592	48	0·89	1,091
1930	Institute ...	26	.....	.....	34	710	.....	.....	401	736	.....	.....	435
	Centres ...	314	1	0·29	10	4,692	50	1·07	92	5,006	51	1·01	102
	Combined ...	340	1	0·29	44	5,402	50	0·93	493	5,742	51	0·89	537

1931	Institute	...	47	.....	.....	42	1,020	3	0·29	394	1,061	3	0·28	433
	Centres	...	328	.....	.....	3	5,670	40	0·70	80	5,998	40	0·69	83
	Combined	...	369	.....	.....	45	6,690	43	0·64	474	7,059	43	0·60	519
1932	Institute	...	40	.....	.....	52	1,207	3	0·24	457	1,247	3	0·24	509
	Centres	...	252	.....	.....	8	5,984	60	1·00	35	6,236	60	0·96	43
	Combined	...	292	.....	.....	60	7,191	63	0·87	492	7,483	63	0·84	552
1933	Institute	...	59	.....	.....	62	1,535	2	0·13	722	1,594	2	0·12	784
	Centres	...	298	.....	.....	8	6,139	31	0·50	32	6,437	31	0·48	40
	Combined	...	357	.....	.....	70	7,674	33	0·43	754	8,031	33	0·41	824
	Grand Total	...	3,235	2	.....	619	56,406	435	0·77	7,955	59,701	437	0·73	8,574

TABLE II.

A general classification of patients attending the Institute during 1933.

	Europeans.					Asiatics.				
	Class of case treated.					Class of case treated.				
	I	II	III	IV	Total.	I	II	III	IV	Total.
Number fully treated	41	6	11	1	59	47	134	1,271	83	1,535
Percentage to total	69·4	10·1	18·6	1·6	...	3·0	8·8	82·8	5·4	...
Total deaths	...	...	...	...	...	...	...	1	1	2
Total death rate per cent. ...	...	...	...	...	...	...	...	0·07	1·2	0·13
Percentage of health returns					100%	.....				96·7
Number not fully treated (presumably at risk)					...	.....				154
Advice cases (not at risk)					62	.....				722
Cases excluded from the statistical tables for other reasons					...	.....				...
Total					62	.....				876
Grand Total					121	.....				2,411

TABLE II-a.

A general classification of patients attending Centres during 1933.

—	Europeans.					Asiatics.				
	Class of case treated.					Class of case treated.				
	I	II	III	IV	Total.	I	II	III	IV	Total.
Number fully treated	180	43	62	13	298	258	1,500	3,467	914	6,139
Percentage to total	60·5	14·4	20·8	4·3	...	4·2	24·5	56·5	14·8	...
Total deaths	...	...	...	...	...	...	5	7	19	31
Total death rate per cent. ...	...	...	...	...	...	...	0·33	0·20	2·0	0·50
Percentage of health returns					88·5		.....			73·6
Number not fully treated (presumably at risk)					19		.....			980
Advice cases (not at risk)					8		.....			32
Cases excluded from the statistical tables for other reasons...					...		.....			...
Total					27		.....			1,012
Grand Total					325		.....			7,151

TABLE III.

Classification of patients according to position of wounds, interposition of clothing and probability of rabies in the biting animal.

Numerators—Deaths. Institute. *Denominators*—Cases.

A—Animal proved rabid.
B—Animal certified rabid.
C—Animal probably rabid according to history.
D—History of animal unknown.
E—Animal probably not rabid according to history.

	Europeans.							Asiatics.							Total.	Death rate per cent.
	A	B	C	D	E	Total.	Death rate per cent.	A	B	C	D	E	Total	Death rate per cent.		
Bitten on face	...	...	...	1	...	1	...	2	...	4	28	...	34	...	35	...
Bitten on trunk and extremities (bare skin)	...	...	2	5	...	7	...	1/32	4	131	1/914	...	2/1081	0·18	2/1088	0·18
Bitten on trunk and extremities (through clothing)	10	1	...	1	...	12	...	7	2	31	333	...	373	...	385	...
"Licks" on any part of the body ...	21	12	6	...	...	39	...	24	17	4	2	...	47	...	86	...
Total ...	31	13	8	7	...	59	...	1/65	23	170	1/1277	...	2/1535	0·13	2/1594	0·12
Percentage to total ...	52·5	22·0	13·5	11·8	...	...	...	4·2	1·5	11·1	83·2	...	...	...	...	...
Death rate ...	...	...	...	...	...	...	...	1·5	...	...	0·07	...	...	...	...	...

TABLE III-a.

Classification of patients according to the position of wounds, interposition of clothing and probability of rabies in the biting animal.

Numerators—Deaths. Centres. *Denominators*—Cases.

A—Animal proved rabid.
B—Animal certified rabid.
C—Animal probably rabid according to history.
D—History of animal unknown.
E—Animal probably not rabid according to history.

	Europeans.							Asiatics.							Total.	Death rate per cent.
	A	B	C	D	E	Total.	Death rate per cent.	A	B	C	D	E	Total.	Death rate per cent.		
Bitten on face	...	2	2	3	...	7	...	2	1/19	10/281	2/43	...	13/345	3·7	13/352	3·6
Bitten on trunk and extremities (bare skin)	...	9	42	34	...	85	...	13	1/183	13/2887	2/1009	...	16/4092	0·39	16/4177	0·38
Bitten on trunk and extremities (through clothing)	...	...	9	5	...	14	...	6	143	2/1023	253	...	2/1425	0·14	2/1439	0·13
"Licks" on any part of the body ...	31	45	100	3	13	192	...	29	93	126	26	...	277	...	469	...
Total ...	31	56	153	45	13	298	...	50	2/441	25/4317	4/1331	...	31/6139	0·50	31/6437	0·48
Percentage to total ...	10·4	18·8	51·4	15·1	4·3	...	...	0·8	7·2	70·3	21·7	...	...	...	...	...
Death rate ...	...	...	...	...	...	...	...	...	0·45	0·57	0·30	...	...	...	...	...

TABLE IV.

Age and sex distribution of patients treated at the Institute.

Numerator—Deaths. *Denominators*—Cases.

Age in years.	Europeans.				Asiatics.				Europeans and Asiatics combined.	
	Males.	Females.	Total.	Death rate per cent.	Males.	Females.	Total.	Death rate per cent.	Total.	Death rate per cent.
0—4	4	4	8	...	28	18	46	...	54	...
5—9	1	...	1	...	135	1/58	1/193	0·51	1/194	0·51
10—14	2	2	4	...	166	35	201	...	205	...
15—19	1	5	6	...	119	17	136	...	142	...
20—29	11	6	17	...	329	40	369	...	386	...
30—39	6	5	11	...	1/246	38	1/284	0·35	1/295	0·33
40—49	5	6	11	...	140	50	190	...	201	...
50—59	1	...	1	...	48	27	75	...	76	...
60—69	...	...	...	...	23	12	35	...	35	...
70 and over	...	...	...	...	4	2	6	...	6	...
Total ...	31	28	59	...	1/1338	1/297	2/1535	0·13	2/1594	0·12

TABLE IV-a.

Age and sex distribution of patients treated at the Centres.

Numerator—Deaths. *Denominators*—Cases.

Age in years.	Europeans.				Asiatics.				Europeans and Asiatics combined.	
	Males.	Females.	Total.	Death rate per cent.	Males.	Females.	Total.	Death rate per cent.	Total.	Death rate per cent.
0—4	14	8	22	...	3/217	78	3/295	1·0	3/317	0·94
5—9	18	11	29	...	6/781	5/275	11/1056	1·0	11/1085	1·0
10—14	14	9	23	...	3/710	1/152	4/862	0·46	4/885	0·45
15—19	10	5	15	...	1/370	99	1/469	0·21	1/484	0·20
20—29	61	30	91	...	3/1096	3/225	6/1321	0·45	6/1412	0·42
30—39	41	19	60	...	1/855	177	1/1032	0·09	1/1092	0·09
40—49	23	19	42	...	452	2/164	2/616	0·32	2/658	0·30
50—59	7	5	12	...	1/231	97	1/328	0·30	1/340	0·27
60—69	2	2	4	...	2/88	47	2/135	1·4	2/139	1·4
70 and over	...	...	...	...	19	6	25	...	25	...
Total ...	190	108	298	...	20/4819	11/1320	31/6139	0·50	31/6437	0·48

TABLE V.

Classification according to number and position of wounds.

Numerators—Deaths. *Denominators*—Cases.

Europeans.
Institute.

Separate table for Europeans and Asiatics: Also for Institute and Centres—

V. Europeans—Institute.
V-a. „ —Centres.
V-b. Asiatics—Institute.
V-c. „ —Centres.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg	...	3	2	...	...	...	...	...	...	1	...	...	...	...	...	...	6	...
Trunk	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Arm	39	4	5	...	2	...	...	1	...	...	...	...	...	...	...	...	51	...
Multiple	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	1	...
Face	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	...
Multiple face ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	39	7	7	...	3	1	...	1	...	1	...	...	...	...	...	...	59	...
Percentage death rate.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE V-a.

Classification according to number and position of wounds.

Numerators—Deaths. *Denominators*—Cases.

Europeans.

Centres.

Separate table for Europeans and Asiatics : Also for Institute and Centres—

V. Europeans—Institute.
V-a. ,, —Centres.
V-b. Asiatics—Institute.
V-c. ,, —Centres.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg	...	13	10	7	3	2	2	...	...	...	...	...	...	...	...	...	37	...
Trunk	...	...	1	...	1	1	...	...	...	...	...	...	...	...	...	...	3	...
Arm	192	22	15	7	6	1	2	1	...	...	1	...	...	...	...	1	248	...
Multiple	...	...	1	...	...	...	...	...	...	2	...	...	...	...	...	...	3	...
Face	...	1	3	...	...	1	...	...	...	...	...	...	...	...	...	...	5	...
Multiple face ...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	2	...
Total ...	192	36	30	15	10	6	4	1	...	2	1	...	...	...	...	1	298	...
Percentage death rate.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE V-b.

Classification according to number and position of wounds.

Numerators—Deaths. *Denominators*—Cases.

Asiatics.

Institute.

Separate table for Europeans and Asiatics : Also for Institute and Centres—

V. Europeans—Institute.
V-a. „ —Centres.
V-b. Asiatics—Institute.
V-c. „ —Centres.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg	...	172	466	153	184	36	33	12	5	2	2	...	1	...	...	...	1063	...
Trunk	...	2	16	3	4	...	1	1	...	...	...	...	...	...	...	...	27	...
Arm	47	1/61	131	37	50	23	15	7	1	...	2	2	...	...	...	...	1/376	0·28
Multiple	...	...	4	2	4	3	8	1	3	2	1	2	1	...	...	...	31	...
Face	...	3	10	4	4	3	3	...	...	...	...	...	...	...	...	...	27	...
Multiple face ...	...	...	...	....	2	1	2	1	1/1	...	...	...	...	1	...	...	1/8	12·5
Total ...	47	1/238	627	199	248	66	62	22	1/10	4	5	4	2	1	...	...	2/1535	...
Percentage death rate.	0·41	...	...	...	...	...	...	...	10·0	...	...	...	...	...	...	...	0·13	...

TABLE V-c.

Classification according to number and position of wounds.

Numerators—Deaths. *Denominators*—Cases.

Asiatics.

Centres.

Separate table for Europeans and Asiatics : Also for Institute and Centres—

V. Europeans—Institute.

V-a. „ —Centres.

V-b. Asiatics—Institute.

V-c. „ —Centres.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg	...	1/799	3/1156	2/752	3/519	163	116	46	29	9	10	3	8	3	2	...	9/3620	0·24
Trunk	...	51	53	41	29	8	10	...	1	...	...	...	...	...	...	...	193	...
Arm	277	2/328	2/427	264	2/209	1/62	54	25	21	6	9	2	4	3	2	3	7/1695	0·41
Multiple	...	...	28	1/45	49	37	42	1/19	19	13	7	7	5	3	3	8	2/285	0·70
Face	...	1/59	2/66	1/52	1/42	1/8	8	1/2	4	...	1	...	...	1	...	1/1	8/244	3·2
Multiple face ...	...	...	13	2/15	1/13	17	17	2/8	6	2	2	...	2	...	2	4	5/101	4·9
Total ...	277	4/1237	7/1743	6/1169	7/861	2/300	247	4/100	80	30	29	12	19	10	9	1/16	31/6139	0·50
Percentage death rate.	...	0·32	0·51	0·51	0·81	0 66	...	4·0	...	...	...	...	...	...	...	5·0	...	...

TABLE VI.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. *Denominators*—Cases.

Europeans.

Institute.

Deep.	Bare.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
+	+	...	3	1	...	1	1	...	...	...	1	...	...	...	...	...	...	7	...
+	—	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...
—	+	39	4	4	...	2	...	...	1	...	...	...	...	...	...	...	...	50	...
—	—	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...		39	7	7	...	3	1	...	1	...	1	...	...	...	...	...	...	59	...
Percentage death rate.		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VI-a.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. *Denominators*—Cases.

Europeans.

Centres.

Deep.	Bare.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
+	+	...	17	10	4	4	3	3	...	...	1	1	...	...	...	...	...	43	...
+	−	...	3	1	1	1	1	...	...	...	...	...	...	...	...	...	...	7	...
−	+	192	13	17	10	3	2	1	1	...	1	...	...	...	...	...	1	241	...
−	−	...	3	2	...	2	...	...	...	...	...	...	...	...	...	...	...	7	...
Total ...		192	36	30	15	10	6	4	1	...	2	1	...	...	...	...	1	298	...
Percentage death rate.		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VI-b.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. *Denominators*—Cases.

Asiatics.

Institute.

Deep.	Bare.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
+	+	...	133	428	141	186	51	43	19	1/7	4	3	4	1	1	...	....	1/1021	0·09
+	—	...	58	110	43	55	12	17	2	2	...	1	...	...	...	...	...	300	...
—	+	47	1/30	48	6	5	2	1	1	...	...	...	...	1	...	...	...	1/141	0·70
—	—	...	17	41	9	2	1	1	...	1	...	1	...	...	...	...	...	73	...
Total ...		47	1/238	627	199	248	66	62	22	1/10	4	5	4	2	1	...	...	2/1535	0·13
Percentage death rate.		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VI-c.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. *Denominators*—Cases.

Asiatics.

Centres.

Deep.	Bare.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
+	+	...	1/477	6/887	5/642	7/515	1/162	156	4/61	42	23	20	10	13	6	5	1/14	25/3033	0·82
+	–	...	198	225	160	129	64	38	17	16	3	1	1	2	4	1	1	860	...
–	+	277	2/397	1/445	254	151	1/45	34	18	17	3	5	1	3	...	2	1	4/1653	0·24
–	–	...	1/165	186	1/113	66	29	19	4	5	1	3	...	1	...	1	...	2/593	0·33
Total ...		277	4/1237	7/1743	6/1169	7/861	2·300	247	4/100	80	30	29	12	19	10	9	1/16	31/6139	0·50
Percentage death rate.		...	0·32	0·51	0·51	0·81	0·66	...	4·0	...	...	...	...	...	...	...	5·0	...	....

TABLE VII.

Classification according to number of wounds and lateness of arrival.

Numerators—Deaths. *Denominators*—Cases.

Europeans.

Institute.

Days late.	Number of wounds.																Total.	Percentage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.		
0 ...	1	2	3	...	2	1	...	...	...	...	...	...	...	...	...	...	9	...
1 ...	7	3	2	...	...	...	...	1	...	...	...	...	...	...	...	...	13	...
2 ...	6	...	1	...	1	...	...	...	...	1	...	...	...	...	...	...	9	...
3 ...	6	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	...
4 ...	6	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	7	...
5 ...	3	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	3	...
6 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7 ...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...
8 to 14 ...	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...
15 to 21 ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
22 to 28 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29 to 35 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36 to 42 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50 and over ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	39	7	7	...	3	1	...	1	...	1	...	...	...	...	...	...	59	...
Percentage death rate. ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VII-a.

Classification according to number of wounds and lateness of arrival.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Centres.

Days late	Number of wounds																Total	Percentage death rate
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over		
0 ...	15	4	7	2	2	...	1	...	...	1	...	...	...	...	...	...	32	...
1 ...	46	12	5	8	5	2	2	1	...	...	1	...	...	...	...	1	83	...
2 ...	20	2	4	2	2	1	1	...	...	...	...	...	...	...	...	...	32	...
3 ...	16	5	6	1	1	1	...	...	...	...	...	...	...	...	...	...	30	...
4 ...	9	4	3	1	...	...	...	...	...	...	...	...	...	...	...	...	17	...
5 ...	23	2	...	1	...	2	...	...	...	...	...	...	...	...	...	...	28	...
6 ...	7	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8	...
7 ...	18	3	3	...	...	...	...	...	...	...	...	...	...	...	...	...	24	...
8 to 14 ...	32	3	2	...	...	...	...	...	...	...	...	...	...	...	...	...	37	...
15 to 21 ...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	...
22 to 28 ...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	1	...
29 to 35 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36 to 42 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50 and over ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	192	36	30	15	10	6	4	1	...	2	1	...	...	...	...	1	298	...
Percentage death rate ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VII-b.

Classification according to number of wounds and lateness of arrival.

Numerators—Deaths. Asiatics. *Denominators*—Cases.

Institute.

Days late	Number of wounds																Total	Percentage death rate
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over		
0 ...	...	40	129	43	67	20	25	9	1/5	2	2	2	1	1	...	....	1/346	0·28
1 ...	14	85	255	92	94	25	21	9	2	1	...	1	...	...	...	...	599	...
2 ...	4	25	75	20	24	7	4	1	...	...	1	...	1	...	...	...	162	...
3 ...	9	12	29	17	19	5	3	1	...	...	1	...	...	...	...	...	96	...
4 ...	3	1/16	29	4	12	2	5	...	1	...	1	...	...	...	...	...	1/73	1·3
5 ...	1	8	16	7	9	4	...	...	1	1	...	...	...	...	...	...	47	...
6 ...	8	5	12	4	3	...	...	1	1	...	...	...	...	...	...	...	34	...
7 ...	2	5	4	...	4	1	1	...	...	...	...	...	...	...	...	...	17	...
8 to 14 ...	6	28	43	5	9	2	1	...	...	...	...	...	...	...	...	...	94	...
15 to 21 ...	...	8	18	3	5	...	1	...	...	...	...	...	...	...	...	...	35	...
22 to 28 ...	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	2	...
29 to 35 ...	...	2	3	2	1	...	...	...	...	...	...	...	...	...	...	...	8	...
36 to 42 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...
50 and over ...	...	4	11	2	1	...	1	1	...	...	...	...	...	...	...	...	20	...
Total ...	47	1/238	627	199	248	66	62	22	1/10	4	5	4	2	1	...	...	2/1,535	0·13
Percentage death rate ...	...	0·41	...	...	...	...	...	...	10·0	...	...	...	...	...	...	...	...	...

TABLE VII-c.

Classification according to number of wounds and lateness of arrival.

Numerators—Deaths. Asiatics. *Denominators*—Cases.

Centres.

Days late	Number of wounds																Total	Percentage death rate
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over		
0 ...	30	1/32	42	34	36	11	4	1/7	3	1	2	...	1	...	...	1	2/204	0·98
1 ...	49	226	1/292	2/208	143	1/65	47	21	14	1	6	1	6	2	2	1	4/1,084	0·36
2 ...	31	1/163	2/273	2/207	149	59	38	1/16	13	4	6	3	4	4	1	4	6/975	0·61
3 ...	25	1/226	3/341	1/228	3/162	1/47	51	2/27	16	7	9	4	3	...	3	5	11/1,154	0·95
4 ...	32	178	251	163	2/120	27	25	8	5	4	2	1	1	1	...	1	2/819	0·24
5 ...	29	82	140	70	62	22	18	4	10	2	...	3	1	...	2	...	445	...
6 ...	15	82	83	64	42	11	20	7	5	2	1	...	1	...	...	2	335	...
7 ...	12	1/43	49	27	28	10	6	5	3	4	1	...	...	2	...	...	1/190	0·52
8 to 14 ...	36	133	168	114	1/74	29	31	5	9	3	2	...	2	1	1	1/1	2/609	0·32
15 to 21 ...	5	32	49	1/25	1/21	7	6	...	1	2	...	...	...	...	...	1	2/149	1·4
22 to 28 ...	...	4	1/14	6	8	2	...	...	...	...	...	...	...	...	...	...	1/34	2·6
29 to 35 ...	2	14	20	9	10	4	...	...	...	...	...	...	...	...	...	...	59	...
36 to 42 ...	...	2	...	4	...	...	...	...	...	...	...	...	...	...	...	...	6	...
43 to 49 ...	5	3	4	7	4	1	...	...	...	...	...	...	...	...	...	...	24	...
50 and over...	6	17	17	3	2	5	1	...	1	...	...	...	...	...	...	...	52	...
Total ...	277	4/1,237	7/1,743	6/1,169	7/861	2/300	247	4/100	80	30	29	12	19	10	9	1/16	31/6,139	0·50
Percentage death rate.	...	0·32	0·51	0·51	0·81	0·66	...	4·0	...	...	...	...	...	...	...	5·0	...	...

TABLE VIII.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Institute.

Deep	Bare	Leg	Trunk	Arm	Multiple	Face	Multiple face	Total	Percentage death rate
+	+	2	...	3	1	...	1	7	...
+	—	2	...	...	...	...	...	2	...
—	+	2	...	48	...	...	...	50	...
—	—	...	...	...	...	...	...	...	...
Total ...		6	...	51	1	...	1	59	...
Percentage death rate.		...	...	...	...	...	...	...	...

TABLE VIII-a.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Centres.

Deep	Bare	Leg	Trunk	Arm	Multiple	Face	Multiple face	Total	Percentage death rate
+	+	15	2	24	1	...	1	43	...
+	—	4	...	2	1	...	...	7	...
—	+	15	...	219	1	5	1	241	...
—	—	3	1	3	...	...	...	7	...
Total ...		37	3	248	3	5	2	298	...
Percentage death rate.		...	...	...	...	...	...	...	...

TABLE VIII-b.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators—Deaths. Asiatics. *Denominators*—Cases.
Institute.

Deep	Bare	Leg	Trunk	Arm	Multiple	Face	Multiple face	Total	Percentage death rate
+	+	714	4	244	24	27	1/8	1/1,021	0·09
+	—	247	13	36	4	...	...	300	...
—	+	52	...	1/87	2	...	...	1/141	0·70
—	—	53	10	9	1	...	...	73	...
Total ...		1,066	27	1/376	31	27	1/8	2/1,535	0·13
Percentage death rate.		...	...	0·28	...	...	12·5	...	...

TABLE VIII-c.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators—Deaths. Asiatics. *Denominators*—Cases.
Centres.

Deep	Bare	Leg	Trunk	Arm	Multiple	Face	Multiple face	Total	Percentage death rate
+	+	7/1,692	52	4/853	2/177	7/173	5/86	25/3,033	0·82
+	—	599	55	131	49	21	5	860	...
—	+	1/851	47	2/652	45	1/48	10	4/1,653	0·24
—	—	1/478	39	1/60	14	2	...	2/593	0·33
Total ...		9/3,620	193	7/1,696	2/285	8/244	5/101	31/6,139	0·50
Percentage death rate.		0·24	...	0·41	0·70	3·2	4·09	...	...

TABLE IX.

Classification according to position of wounds and lateness of arrival.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Institute.

Days late	Leg	Trunk	Arm	Multiple	Face	Multiple face	Total	Percentage death rate
0 ...	2	...	5	1	...	1	9	...
1 ...	1	...	12	...	...	...	13	...
2 ...	2	...	7	...	...	...	9	...
3 ...	1	...	7	...	...	...	8	...
4 ...	...	...	7	...	...	...	7	...
5 ...	...	...	3	...	...	...	3	...
6 ...	...	...	...	...	...	...	...	...
7 ...	...	...	4	...	...	...	4	...
8 to 14 ...	...	...	5	...	...	...	5	...
15 to 21 ...	...	...	1	...	...	...	1	...
22 to 28 ...	...	...	...	...	...	...	...	...
29 to 35 ...	...	...	...	...	...	...	...	...
36 to 42 ...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	...	...	...	...	...	...
50 and over ...	...	...	...	...	...	...	...	...
Total ...	6	...	51	1	...	1	59	...
Percentage death rate. ...	...	...	...	...	...	...	...	...

TABLE IX-a.

Classification according to position of wounds and lateness of arrival.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Centres.

Days late	Leg	Trunk	Arm	Multiple	Face	Multiple face	Total	Percentage death rate
0 ...	4	...	27	1	...	...	32	...
1 ...	18	1	62	...	1	1	83	...
2 ...	5	...	27	...	...	...	32	...
3 ...	7	1	22	...	...	...	30	...
4 ...	...	...	15	...	2	...	17	...
5 ...	...	1	25	...	1	1	28	...
6 ...	1	...	7	...	...	...	8	...
7 ...	...	...	23	...	1	...	24	...
8 to 14 ...	2	...	34	1	...	...	37	...
15 to 21 ...	...	...	6	...	...	...	6	...
22 to 28 ...	...	...	...	1	...	...	1	...
29 to 35 ...	...	...	...	...	...	...	...	...
36 to 42 ...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	...	...	...	...	...	...
50 and over ...	...	...	...	...	...	...	...	...
Total ...	37	3	248	3	5	2	298	...
Percentage death rate.	...	...	...	...	...	...	...	...

TABLE IX-b.

Classification according to position of wounds and lateness of arrival.

Numerators—Deaths. Asiatics. *Denominators*—Cases.

Institute.

Days late	Leg	Trunk	Arm	Multiple	Face	Multiple face	Total	Percentage death rate
0 ...	248	5	69	7	10	1/7	1/346	0·28
1 ...	428	14	131	17	9	...	599	...
2 ...	114	3	40	1	3	1	162	...
3 ...	60	2	29	4	1	...	96	...
4 ...	44	...	1/27	...	2	...	1/73	1·3
5 ..	37	...	9	...	1	....	47	...
6 ...	16	...	18	...	...	...	34	...
7 ...	12	1	4	...	...	...	17	...
8 to 14 ...	58	2	33	1	...	...	94	...
15 to 21 ...	26	...	9	...	...	...	35	...
22 to 28 ...	...	...	1	1	...	...	2	...
29 to 35 ...	5	...	3	...	....	...	8	...
36 to 42 ...	...	...	...	...	...	...	...	...
43 to 49 ...	2	...	...	...	...	...	2	...
50 and over ...	16	...	3	...	1	...	20	...
Total ...	1,066	27	1/376	31	27	1/8	2/1,535	0·13
Percentage death rate.	...	...	0·28	...	...	12·5	...	...

TABLE IX-c.

Classification according to position of wounds and lateness of arrival.

Numerators—Deaths. Asiatics Centres. *Denominators*—Cases.

Days late	Leg	Trunk	Arm	Multiple	Face	Multiple face	Total	Percentage death rate.
0 ...	103	3	77	13	2/6	2	2/204	0·98
1 ...	663	42	1/264	42	2/51	1/22	4/1084	0·36
2 ...	1/569	25	2/261	1/51	45	2/24	6/975	0·61
3 ...	4/685	44	2/280	1/65	3/63	1/17	11/1154	0·95
4 ...	494	32	1/220	37	27	1/9	2/819	0·24
5 ...	249	10	141	17	18	10	445	...
6 ...	203	9	101	16	4	2	335	...
7 ...	1/105	4	64	12	3	2	1/190	0·52
8 to 14 ...	1/355	18	180	27	1/21	8	2/609	0·32
15 to 21 ...	1/96	2	1/47	1	2	1	2/149	1·4
22 to 28 ...	1/25	1	6	2	....	...	1/34	2·6
29 to 35 ...	31	3	20	1	2	2	59	...
36 to 42 ...	6	...	...	...	....	...	6	...
43 to 49 ...	14	...	10	...	...	...	24	...
50 and over ...	22	...	25	1	2	2	52	...
Total ...	9/3620	193	7/1696	2/285	8/244	5/101	31/6139	0·50
Percentage death rate.	0·24	....	0·41	0·70	3·2	4·9	...	...

TABLE X.

Deaths from hydrophobia amongst persons treated in

Europeans,

Institute.

Serial Number	Case Number	Number of days from commencement of treatment to onset of symptoms.	Sex	Age in years	Biting animal		Number and position of wounds					Wounds			Number of days late	Duration of illness in days	Interval between bite and death in days	Class of cases	Treatment		Remarks
					Kind	Class	Leg	Trunk	Arm	Face	Total	Deep	Extensive	Bare skin	Uncauterised					Type	Duration in days	
←									*Nil*												→

TABLE X-a.

Deaths from hydrophobia amongst persons treated in

Europeans,

Centres.

Serial Number	Case Number	Number of days from commencement of treatment to onset of symptoms	Sex	Age in years	Biting animal		Number and position of wounds					Wounds			Number of days late	Duration of illness in days	Interval between bite and death in days	Class of cases	Treatment		Remarks
					Kind	Class	Leg	Trunk	Arm	Face	Total	Deep	Extensive	Bare skin	Uncauterised					Type	Duration in days	
←									*Nil*												→

TABLE X-b.

Deaths from hydrophobia amongst persons treated in

Asiatics.

Institute.

Serial Number.	Case Number.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and position of wounds.					Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.	
					Kind.	Class.	Leg.	Trunk.	Arm.	Face.	Total.	Deep.	Extensive.	Bare skin.	Uncauterised.					Type.	Duration in days.
1	60	19	M.	32	Dog ...	A	...	...	1	...	1	+	+	+	+	4	2	25	III	5 cc.	5 per cent. 14 days.
2	7	27	F.	7	Dog ...	D	...	...	1	7	8	+	-	+	+	...	3	30	IV	7 cc.	5 per cent. 14 days.

TABLE

Deaths from hydrophobia amongst

Asiatics.

Centres.

Serial Number.	Case Number.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and position of wounds.				
					Kind.	Class.	Leg.	Trunk.	Arm.	Face.	Total.
										Died	during
1	84	7	M.	20	Dog ...	C	...	...	4	...	4
2	7	9	M.	7	Dog ...	C	...	...	...	2	2
3	209	10	M.	8	Dog ...	D	...	...	...	2	2
									Died	within	15 days
1	51	15	M.	5	Dog ...	C	...	2	...	1	3
2	32	15	M.	68	Dog ...	C	...	...	2	2	4
3	126	15	M.	8	Dog ...	C	...	...	4	...	4
4	809	16	F.	9	Dog ...	B	...	...	...	2	2
5	328	16	M.	15	Jackal ...	C	...	...	5	2	7
6	34	16	F.	25	Dog ...	D	3	...	...	...	3
7	14	18	M.	22	Dog ...	C	4	...	...	...	4
8	90	19	M.	24	Dog ...	C	...	...	...	1	1
9	238	19	F.	20	Jackal ...	C	...	...	3	4	7
10	14	22	F.	5	Dog ...	C	...	...	...	5	5
11	278	22	F.	6	Dog ...	B	...	...	1	...	1
12	198	23	M.	13	Jackal ...	C	4	...	...	...	4
13	140	23	M.	8	Dog ...	C	...	...	...	2	2
14	114	24	F.	20	Dog ...	C	...	...	5	...	5
									Died	after	15 days
1	109	27	M.	6	Dog ...	C	2	...	...	...	2
2	9	28	M.	9	Dog ...	D	...	...	...	7	7
3	552	28	M.	13	Dog ...	D	2	...	...	...	2
4	200	33	M.	5	Dog ...	C	...	...	1	...	1
5	722	36	M.	3	Dog ...	C	2	...	...	...	2
6	385	37	M.	60	Jackal ...	C	...	...	4	...	4
7	216	38	M.	3	Dog ...	C	...	...	...	4	4
8	168	45	F.	9	Dog ...	C	...	...	2	1	3
9	226	57	F.	40	Dog ...	C	1	...	2	...	3
10	180	65	M	4	Jackal ...	D	...	...	...	20	20

X-c.

persons treated in

Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.	
Deep.	Extensive.	Bare skin.	Uncauterised.					Type.	Duration in days.
treatment.									
+	−	+	+	30	2	39	III	5 cc.	5 per cent. 7 days.
+	−	+	+	16	2	27	IV	7 cc.	5 per cent. 8 days.
+	−	+	+	7	1	18	IV	7 cc.	5 per cent. 11 days.
after treatment									
+	+	+	−	2	1	18	IV	10 cc.	5 per cent. 14 days.
+	−	+	+	4	6	25	IV	10 cc.	Do.
+	+	+	+	15	2	32	III	4 cc.	Do.
−	−	+	+	3	2	21	IV	3·5 cc.	Do.
+	−	+	+	3	3	23	IV	10 cc.	Do.
+	−	+	+	21	1	38	IVE	7 cc.	Do.
+	−	+	+	3	3	24	III	5 cc.	Do.
+	+	+	+	0	1	20	IV	10 cc.	Do.
+	−	+	+	2	1	22	IV	10 cc.	Do.
+	−	+	+	1	2	25	IV	7 cc.	Do.
−	−	+	−	3	1	26	II	2 cc.	Do.
+	−	+	+	3	2	28	III	4 cc.	Do.
+	+	+	+	3	2	28	IV	7 cc.	Do.
−	−	+	+	3	1	28	II	2 cc.	Do.
after treatment.									
+	−	+	+	3	3	33	IVE	5 cc.	5 per cent. 14 days.
+	−	+	+	0	2	30	IV	7 cc.	Do.
+	−	+	−	2	2	32	III	5 cc.	Do.
−	−	−	−	2	2	37	II	2 cc.	Do.
+	−	+	+	25	1	62	III	3·5 cc.	Do.
+	−	+	+	4	3	44	IVE	7 cc.	Do.
+	−	+	−	3	2	44	V	7 cc.	Do.
+	−	+	+	1	2	48	IV	7 cc.	Do.
+	−	+	+	2	2	61	IVE	7 cc.	Do.
+	−	+	+	8	2	75	IV	7 cc.	Do.

TABLE

Serial Number.	Case Number.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and position of wounds.				
					Kind.	Class.	Leg.	Trunk.	Arm.	Face.	Total.
11	36	74	F.	9	Dog ...	C	...	...	2	...	2
12	99	80	M.	30	Jackal ...	C	1	...	...	...	1
13	548	85	F.	10	Dog ...	C	...	...	2	...	2
14	567	88	M.	10	Dog ...	C	3	...	...	..	3
15	282	169	M.	65	Dog ...	C	4	...	...	..	4
16	21	179	F.	45	Dog ...	C	...	...	...	3	3
17	250	217	M.	25	Dog ...	C	3	...	4	...	7

X-c.—*contd.*

Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.	
Deep.	Extensive.	Bare skin.	Uncauterised.					Type.	Duration in days.
+	+	+	+	1	4	79	IVE	7 cc.	5 per cent. 14 days.
+	+	+	+	7	3	90	II	2 cc.	Do.
+	+	+	+	1	4	79	IVE	7 cc.	Do.
+	+	+	+	3	3	94	II	2 cc.	Do.
+	+	+	—	8	3	180	III	5 cc.	Do.
+	—	+	+	1	3	183	IV	10 cc.	Do.
+	—	+	+	3	2	322	IVE	7 cc.	Do.

TABLE

Classification of the animal which bit,

Numerators—Death.

Animal.	Institute.								
	Number treated.			Percentage to total.			Death rate per cent.		
	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.
Dog ...	59	2/1476	2/1535	...	96·1	96·3	0·13	0·13	280
Jackal ...	...	16	16	...	1·0	1·0	...	...	1
Cat ...	...	28	28	...	1·8	1·8	...	...	4
Monkey ...	...	5	5	...	0·3	0·3	...	...	4
Fok ...	...	...	...	...	...	...	...	...	...
Human Beings ...	...	6	6	...	0·3	0·3	...	...	8
Donkey ...	...	...	...	...	...	...	...	...	...
Horse ...	...	2	2	...	0·1	0·1	...	...	...
Buffalow ...	...	...	...	...	...	...	...	...	...
Hyena ...	...	...	...	...	...	...	...	...	...
Wolf ...	...	...	...	...	...	...	...	...	...
Cow ...	...	...	...	...	...	...	...	...	...
Goat ...	...	...	...	...	...	...	...	...	...
Leopard ...	...	...	...	...	...	...	...	...	...
Calf ...	...	...	...	...	...	...	...	...	...
Bullock ...	...	...	...	...	...	...	...	...	...
Rabbit ...	...	...	...	...	...	...	...	...	...
Mangoose ...	...	1	1	...	0·06	0·06	...	...	...
Pig ...	...	1	1	...	0·06	0·06	...	...	...
Unknown ...	...	...	...	...	...	...	...	...	1
Total ...	59	2/1535	2/1594	...	...	...	...	...	298

XI.

scratched or licked the patient.

Denominators—Cases.

CENTRES.								
Number treated.			Percentage to total.			Death rate per cent.		
Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.
280	25/5306	25/5586	93·9	86·4	86·7	.....	0·47	0·44
1	6/670	6/671	0·3	10·9	10·4	.....	0·89	0·89
4	8	12	1·3	0·1	0·1	.....	...	...
4	21	25	1·3	0·3	0·3	.....	...	...
.....	3	3	.....	0·04	0·04	.....	...	...
8	48	56	2·7	0·7	0·8	.....	...	...
.....	18	18	.....	0·2	0·2	.....	...	...
.....	25	25	.....	0·4	0·3	.....	...	...
.....	4	4	.....	0·06	0·06	.....	...	...
.....	8	8	.....	0·1	0·1	.....	...	...
.....	3	3	.....	0·04	0·04	.....	...	...
.....	2	2	.....	0·02	0·02	.....	...	...
.....	1	1	.....	0·01	0·01	.....	...	...
.....	.....	.....	.....	...	...	.....	...	...
.....	17	17	.....	0·2	0·2	.....	...	...
.....	2	2	.....	0·02	0·02	.....	...	...
.....	1	1	.....	0·01	0·01	.....	...	...
.....	.....	.....	.....	...	...	.....	...	...
1	.....	1	0·3	...	...	.....	...	...
.....	2	2	.....	0·02	0·02	.....	...	...
298	31/6139	31/6437	.....	...	...	.....	...	...

TABLE XII.

Number of patients treated by months.

	Institute.			Centres.			Institute and Centres combined.		
	Europeans.	Asiatics.	Total.	Europeans.	Asiatics.	Total.	Europeans.	Asiatics.	Total.
January ...	5	143	148	17	529	546	22	672	694
February ...	...	127	127	36	522	558	36	649	685
March ...	28	162	190	22	600	622	50	762	812
April ...	1	154	155	24	531	555	25	685	710
May ...	3	171	174	45	530	575	48	701	749
June ...	...	137	137	21	557	578	21	694	715
July ...	2	108	110	19	540	559	21	648	669
August ...	5	123	128	23	434	457	28	557	585
September ...	8	73	81	29	481	510	37	554	591
October ...	...	112	112	10	475	485	10	587	597
November ...	6	123	129	17	454	471	23	577	600
December ...	1	102	103	35	486	521	36	588	624
Total ...	59	1,535	1,594	298	6,139	6,437	357	7,674	8,031

TABLE XIII.

Statement showing brains submitted and examined for rabies.

Serial number.	Animal.	Number of brains examined.	Positive.	Negative.	Unfit for examination.
1	Dogs	209	148	52	9
2	Human Beings	1	1	...	.....
3	Goat	1	1	...	.....
4	Cats	3	2	...	1
5	Donkey	1	...	1	.....
6	Monkey	1	...	1	.....
7	Horse	1	...	...	1
8	Guineapig	1	1	...	.....
9	Fowl	1	...	1	.....
	Total ...	219	153	55	11

APPENDIX III.

1934

Statistics of Antirabic Inoculation.

(Standard Tables approved for use in India).

TABLE I.

A general statement regarding patients treated at the Institute and its Centres from 1922 to 1934.

Year.	Europeans.				Asiatics.				Europeans and Asiatics combined.			
	Total treated.	Total deaths.	Total death rate per cent.	Advice cases.	Total treated.	Total deaths.	Total death rate per cent.	Advice cases.	Total treated.	Total deaths.	Total death rate per cent.	Advice cases.
1922 Institute	64	.....	.....	.....	365	4	1·04	175	429	4	0·89	175
1922 Centres	7	.....	.....	.....	236	.....	.....	.....	243	.....	.....	.....
1922 Combined	71	.....	.....	.....	601	4	0·66	175	672	4	0·61	175
1923 Institute	115	.....	.....	59	730	10	1·37	359	845	10	0·18	418
1923 Centres	38	.....	.....	.....	1,521	12	0 78	260	1,559	12	0·76	260
1923 Combined	153	.....	.....	59	2,251	22	0·97	619	2,404	22	0·91	678
1924 Institute	62	1	1·61	41	525	9	1·71	372	587	10	1·70	418
1924 Centres	85	.....	.....	.....	2,880	28	0·97	330	2,965	28	0·94	330
1924 Combined	147	1	0·68	41	3,405	37	1·08	702	3,552	38	1·06	743
1925 Institute	42	.....	.....	27	583	6	1·02	219	625	6	0·96	246
1925 Centres	187	.....	.....	5	3,569	28	0·78	393	3,756	28	0·78	398
1925 Combined	229	.....	.....	32	4,152	34	0·81	612	4,381	34	0·79	644
1926 Institute	60	.....	.....	51	588	5	0·87	440	648	5	0·76	491
1926 Centres	287	.....	.....	20	5,861	25	0·64	322	4,148	25	0·60	342
1926 Combined	347	.....	.....	71	4,449	30	0·67	762	4,796	30	0·60	833
1927 Institute	51	.....	.....	37	678	6	0·88	468	729	2	0·82	505
1927 Centres	303	...	.....	31	3,857	25	0·64	490	4,160	25	0·62	521
1927 Combined	354	.....	.....	68	4,535	31	0·68	958	4,889	31	0·61	1,026
1928 Institute	39	.....	.....	40	679	6	0·88	418	718	6	0·83	458
1928 Centres	216	.....	.....	27	4,166	34	0·81	467	4,382	34	0·77	494
1928 Combined	255	.....	.....	67	4,845	40	0 82	885	5,100	40	0·78	952
1929 Institute	35	.....	.....	43	650	5	0 77	522	685	5	0·73	565
1929 Centres	286	.....	.....	19	4,621	43	0·93	507	4,907	43	0·89	526
1929 Combined	321	.....	.....	62	5,271	48	0·91	1,029	5,592	48	0·89	1,091
1930 Institute	26	.....	.....	34	710	.....	.....	401	736	.....	.....	435
1930 Centres	314	1	0·29	10	4,692	50	1·07	92	5,006	51	1·01	102
1930 Combined	340	1	0·29	44	5,402	50	0·93	493	5,742	51	0·89	537

1931	Institute	...	41	.....	.....	42	1,020	3	0·29	394	1,061	3	0·28	486
	Centres	...	328	.....	.....	3	5,670	40	0·70	80	5,008	40	0·69	83
	Combined	...	369	.....	.....	45	6,690	43	0·64	474	7,069	43	0·60	510
1932	Institute	...	40	.....	.....	52	1,207	3	0·24	457	1,247	3	0·24	509
	Centres	...	252	.....	.....	8	5,984	60	1·00	35	6,236	60	0·96	43
	Combined	...	292	.....	.....	60	7,191	63	0·87	492	7,483	63	0·84	552
1933	Institute	...	59	.....	.....	62	1,535	2	0·13	722	1,594	2	0·12	764
	Centres	...	298	.....	.....	8	6,139	31	0·50	32	6,437	31	0·48	40
	Combined	...	357	.....	.....	70	7,674	33	0·43	754	8,031	33	0·41	824
1934	Institute	...	45	.....	.....	49	1,785	4	0·22	665	1,830	4	0·21	714
	Centres	...	344	.....	.....	24	5,462	23	0·42	21	5,806	23	0·39	45
	Combined	...	389	.....	.....	73	7,247	27	0·37	686	7,636	27	0·35	759
Grand Total		...	3,624	2	.....	692	63,713	462	0·72	8,641	67,337	464	0·68	9,333

TABLE II.

A general classification of patients attending the Institute during 1934.

	Europeans.					Asiatics.				
	Class of case treated.					Class of case treated.				
	I	II	III	IV	Total.	I	II	III	IV	Total.
Number fully treated	15	2	27	1	45	49	1/114	1,528	3/94	4/1,785
Percentage to total	33·3	4·5	60·0	2·2	...	2·8	6·4	85·6	5·2	...
Total deaths	...	...	...	...	...	...	1	...	3	4
Total death rate per cent.	...	...	...	...	...	...	0·87	...	3·1	0·22
Percentage of health returns					100					98·2
Number not fully treated (presumably at risk)					...					37
Advice cases (not at risk)					49					665
Cases excluded from the statistical tables for other reasons					...					...
Total					49					702
Grand Total					94					2,487

TABLE II-a.

A general classification of patients attending the Centres during 1934.

	Europeans.					Asiatics.				
	Class of case treated.					Class of case treated.				
	I	II	III	IV	Total.	I	II	III	IV	Total.
Number fully treated	225	41	55	23	344	226	1,061	3,320	855	5,462
Percentage to total	65·4	11·7	16·0	6·9	...	4·1	19·4	60·8	15·7	...
Total deaths	...	...	...	...	...	...	2	8	13	23
Total death rate per cent.	...	...	...	...	...	...	0·18	0·24	1·5	0·42
Percentage of health returns					83·4					76·30
Number not fully treated (presumably at risk)					23					901
Advice cases (not at risk)					24					21
Cases excluded from the statistical tables for other reasons					...					...
Total					47					922
Grand Total					391					6,384

TABLE III.

Classification of patients according to position of wounds, interposition of clothing and probability of rabies in the biting animal.

Numerators—Deaths. Institute. *Denominators*—Cases.

A—Animal proved rabid.
B—Animal certified rabid.
C—Animal probably rabid according to history.
D—History of animal unknown.
E—Animal probably not rabid according to history.

	Europeans.							Asiatics.							Total.	Death rate per cent.
	A	B	C	D	E	Total.	Death rate per cent.	A	B	C	D	E	Total.	Death rate per cent.		
Bitten on face ...	1	...	...	...	...	1	...	3	...	1/13	26	...	1/42	2·3	1/43	2·3
Bitten on trunk and extremities (bare skin).	...	4	12	12	...	28	...	..	18	1/597	2/686	...	3/1,311	0·22	3/1,339	0·22
Bitten on trunk and extremities (through clothing).	...	...	1	...	...	1	...	...	...	182	201	...	383	...	384	..
"Licks" on any part of the body.	12	1	2	...	...	15	...	18	22	5	4	...	49	...	64	...
Total ...	13	5	15	12	...	45	...	21	40	2/797	2/927	...	4/1,785	0·22	4/1,830	0·21
Percentage to total ...	28·8	11·1	33·3	26·2	...	...	...	1·1	2·3	44·7	51·9	...	...	...	...	...
Death rate ...	...	...	...	...	...	...	...	...	...	0·25	0·21	...	...	...	...	...

TABLE III-a.

Classification of patients according to position of wounds, interposition of clothing and probability of rabies in the biting animal.

Numerators—Deaths. Centres. *Denominators*—Cases.

A—Animal proved rabid.
B—Animal certified rabid.
C—Animal probably rabid according to history.
D—History of animal unknown.
E—Animal probably not rabid according to history.

	Europeans.							Asiatics.							Total.	Death rate per cent.
	A	B	C	D	E	Total.	Death rate per cent.	A	B	C	D	E	Total.	Death rate per cent		
Bitten on face ...	1	...	1	2	3	7	...	5	1/15	9/262	1/31	...	11/316	3·40	11/323	3·40
Bitten on trunk and extremities (bare skin).	...	11	41	26	...	78	...	16	110	8/2,231	3/1,403	...	11/3,760	0·29	11/3,838	0·28
Bitten on trunk and extremities (through clothing).	...	...	11	8	...	19	...	...	58	1/772	296	...	1/1,126	0·08	1/1,145	0·08
"Licks" on any part of the body.	70	83	65	15	7	240	...	68	66	110	16	...	260	...	500	...
Total ...	71	94	118	51	10	344	...	89	1/249	18/3,375	4/1,749	...	23/5,462	0·42	23/5,806	0·39
Percentage to total ...	20·5	27·3	34·3	14·8	3·1	...	...	1·6	4·5	61·7	32·2	...	...	...	...	...
Death rate ...	...	...	...	...	...	...	...	...	0·40	0·53	0·22	...	...	...	...	...

TABLE IV.

Age and sex distribution of patients treated at the Institute.

Numerators—Deaths. *Denominators*—Cases.

Age in years.	Europeans.				Asiatics.				Europeans and Asiatics combined.	
	Males.	Females.	Total.	Death rate per cent.	Males.	Females.	Total.	Death rate per cent.	Total.	Death rate per cent.
0—4	...	3	3	...	1/36	1/17	2/53	3·7	2/56	3·5
5—9	4	2	6	...	1/185	65	1/250	0·40	1/256	0·39
10—14	3	2	5	...	195	48	243	...	248	...
15—19	2	...	2	...	131	41	172	...	174	...
20—29	5	4	9	...	1/373	53	1/426	0·23	1/435	0·22
30—39	7	4	11	...	274	47	321	...	332	...
40—49	5	1	6	...	127	55	182	...	188	...
50—59	1	1	2	...	56	41	97	...	99	...
60—69	1	...	1	...	22	15	37	...	38	...
70 and over	...	...	...	...	3	1	4	...	4	...
Total ...	28	17	45	...	3/1,402	1/383	4/1,785	0·22	4/1,830	0·21

TABLE IV-a.

Age and sex distribution of patients treated at the Centres.

Numerators—Deaths. *Denominators*—Cases.

Age in years.	Europeans.				Asiatics.				Europeans and Asiatics combined.	
	Males.	Females.	Total.	Death rate per cent.	Males.	Females.	Total.	Death rate per cent.	Total.	Death rate per cent.
0—4	11	6	17	...	185	78	263	...	280	...
5—9	17	12	29	...	10/726	198	10/924	1·00	10/953	1·00
10—14	21	11	32	...	2/645	129	2/774	0·25	2/806	0·24
15—19	14	9	23	...	2/336	86	2/422	0·47	2/445	0·45
20—29	79	20	99	...	1/967	212	1/1,179	0·08	1/1,278	0·07
30—39	49	27	76	...	2/773	2/167	4/940	0·42	4/1,016	0·39
40—49	34	16	50	...	406	129	535	...	585	...
50—59	7	8	15	...	208	71	279	...	294	...
60—69	...	3	3	...	3/69	1/23	4/92	4·30	4/95	4·20
70 and over	...	...	...	...	35	19	54	...	54	...
Total ...	232	112	344	...	20/4,350	3/1,112	23/5,462	0·42	23/5,806	0·39

TABLE No. V.

Classification according to number and position of wounds.

Numerators = Deaths. *Denominators* = Cases.

Europeans.

Institute.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg ...	...	2	2	4	...	...	1	...	...	...	...	...	...	...	...	...	9	...
Trunk ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....
Arm ...	15	8	2	2	3	...	1	1	...	...	...	...	...	...	...	1	33	.....
Multiple ...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	2	.....
Face ...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	.....
Multiple face ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....
Total ...	15	11	4	6	4	1	2	1	...	...	...	...	...	...	...	1	45	.....
Percentage death rate. ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....

Separate table for Europeans and Asiatics; also for Institute and Centres :—

(V) Europeans—Institute.
(V-a) ,, —Centres.
(V-b) Asiatics —Institute.
(V-c) ,, —Centres.

TABLE No. V-a.

Classification according to number and position of wounds.

Numerators = Deaths. *Denominators* = Cases.

Europeans.

Centres.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg ...	...	5	14	6	2	1	1	1	...	...	...	...	...	...	...	...	30	.....
Trunk ...	...	1	1	...	...	...	...	...	...	...	...	...	..	...	...	...	2	.....
Arm ...	240	20	18	8	10	1	2	...	...	1	1	...	1	1	...	...	303	.....
Multiple ...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	...	...	2	.....
Face ...	...	2	2	2	...	...	...	...	...	...	...	...	...	...	...	...	6	.....
Multiple face ...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	1	.....
Total ...	240	28	35	17	12	2	3	1	1	1	1	1	1	1	...	...	344	.....
Percentage death rate. ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....

Separate table for Europeans and Asiatics; also for Institute and Centres:—

(V) Europeans—Institute.
(V-a) „ —Centres.
(V-b) Asiatics —Institute.
(V-c) „ —Centres.

TABLE No. V-b.

Classification according to number and position of wounds.

Numerators = Deaths. *Denominators* = Cases.

Asiatics.

Institute.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg ...	...	200	463	222	206	88	43	19	6	4	1	3	...	...	...	...	1255	.....
Trunk ...	...	4	12	3	6	4	...	...	...	...	...	...	...	...	...	...	29	.....
Arm ...	49	67	1/111	61	51	1/30	16	12	1/7	4	2	2	...	...	...	....	3/412	0·72
Multiple ...	...	...	4	3	6	8	8	5	5	4	...	2	...	...	...	2	47	.....
Face ...	...	6	12	1	7	1/7	...	2	...	2	...	1	...	...	...	...	1/38	2·80
Multiple face ...	...	...	...	...	1	...	2	...	...	...	...	1	...	...	...	...	4	.....
Total ...	49	277	1/602	290	277	2/137	69	38	1/18	14	3	9	...	...	...	2	4/1785	0·22
Percentage death rate. ...	...	...	0·16	...	...	1·4	...	...	5·5	...	...	...	...	...	...	...	...	.....

Separate table for Europeans and Asiatics; also for Institute and Centres:—

(V) Europeans—Institute.
(V-a) „ —Centres.
(V-b) Asiatics —Institute.
(V-c) „ —Centres.

TABLE No. V-c.

Classification according to number and position of wounds.

Numerators = Deaths. *Denominators* = Cases.

Asiatics.

Centres.

Position.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
Leg ...	...	571	1/1132	653	1/461	1/149	104	54	36	1/19	4	6	6	2	3	4	4/3204	0·12
Trunk ...	...	37	62	39	26	12	9	2	2	...	...	...	1	...	...	....	190	.....
Arm ...	260	2/261	1/381	224	2/207	68	70	20	23	7	10	3	2	3	1	2	5/1542	0·32
Multiple ...	...	...	22	22	1/32	33	2/29	32	9	1/8	6	2	5	1	2	7	4/210	1·90
Face ...	...	3/53	1/57	1/51	1/35	11	2	1/4	4	1	1	1	...	...	...	...	7/220	3·10
Multiple face ...	...	...	10	10	15	1/13	1/12	10	1/9	2	3	1	2	2	1	6	3/96	3·10
Total ...	260	5/922	3/1664	1/999	5/776	2/286	3/226	1/122	1/83	2/37	24	13	16	8	7	19	23/5462	0·42
Percentage death rate. ...	...	0·54	0·18	0·10	0·64	0·69	1·20	0·81	1·20	5·4	...	....	...	...	...	....	...	.....

Separate table for Europeans and Asiatics; also for Institute and Centres.

(V) Europeans—Institute.
(V-a) „ —Centres.
(V-b) Asiatics —Institute.
(V-c) „ —Centres.

TABLE VI.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Institute.

Deep.	Bare.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
+	+	...	3	...	5	4	1	2	1	...	...	...	...	...	...	...	1	17	.....
+	−	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	.....
−	+	15	7	4	1	...	...	...	...	...	...	...	...	...	...	...	...	27	.....
−	−	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	.....
Total ...		15	11	4	6	4	1	2	1	...	...	...	...	...	...	...	1	45	
Percentage death rate.		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	.....

TABLE VI-a.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. Europeans. *Denominators*—Cases.

Centres.

Deep.	Bare.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
+	+	...	3	10	4	5	2	2	1	1	1	1	1	...	1	...	...	32	.....
+	−	...	3	5	1	3	...	...	...	...	...	...	...	...	...	...	...	12	.....
−	+	240	22	17	9	3	...	1	...	...	...	...	...	1	...	...	...	293	.....
−	−	...	...	3	3	1	...	...	...	...	...	...	...	...	...	...	...	7	.....
Total ...		240	28	35	17	12	2	3	1	1	1	1	1	1	1	...	...	344	.....
Percentage death rate.		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	.....

TABLE VI-b.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. Asiatics. *Denominators*—Cases.

Institute.

Deep.	Bare.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
+	+	...	198	406	218	211	2/105	55	32	1/16	10	3	9	...	...	...	2	3/1,260	0·23
+	—	...	32	123	56	59	28	11	5	...	3	...	...	...	...	...	...	317	.....
—	+	49	26	1/41	8	4	1	3	1	2	1	...	...	...	...	...	...	1/136	0·73
—	—	...	21	32	8	8	2	...	...	...	...	...	...	...	...	...	...	66	.....
Total ...		49	277	1/602	290	277	2/137	69	38	1/18	14	3	9	...		...	2	4/1,785	0·22
Percentage death rate.		...	...	0·16	...	...	1·4	...	...	5·5	...	...	...	...	...	...	...	.....	.....

TABLE VI-c.

Classification according to number and depth of wounds and interposition of clothing.

Numerators—Deaths. Asiatics. *Denominators*—Cases.

Centres.

Deep.	Bare.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.	Total.	Percentage death rate.
+	+	...	4/452	3/959	1/623	3/520	2/201	3/159	1/94	1/54	2/27	20	10	11	8	4	16	20/3,158	0·63
+	—	...	121	246	168	1/119	47	37	13	15	5	1	2	3	...	2	2	1/781	0·13
—	+	260	1/256	346	146	1/95	18	25	9	11	2	1	...	2	...	...	1	2/1,172	0·17
—	—	...	93	113	62	42	20	5	6	3	3	2	1	...	...	1	...	351	.....
Total ..		260	5/922	3/1,664	1/999	5/776	2/286	3/225	1/122	1/83	2/37	24	13	16	8	7	19	23/5,462	0·42
Percentage death rate.		...	0·54	0·18	0·10	0·64	0·69	1·20	0·61	1·20	5·40	...	...	...	...	...	...	.....	.....

TABLE VII.

Classification according to number of wounds and lateness of arrival.

Numerators—Deaths. *Denominators*—Cases.

Europeans.

Institute.

Days late.	Number of wounds.															Total.	Percentage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over.		
0 ...	...	2	...	1	1	...	1	...	...	...	...	...	...	...	..	1	6	...
1 ...	...	6	4	3	...	1	1	1	...	...	...	...	...	...	...	...	16	...
2 ...	2	...	...	1	2	...	...	...	...	...	...	..	...	...	...	...	5	...
3 ...	1	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	3	...
4 ...	3	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	4	...
5 ...	6	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	...
6 ...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
7 ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
8 to 14 ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
15 to 21 ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
22 to 28 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29 to 35 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36 to 42 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50 and over ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	15	11	4	6	4	1	2	1	...	...	...	...	...	...	...	1	45	...
Percentage death rate.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VII-a.

Classification according to number of wounds and lateness of arrival.

Numerators—Deaths. *Denominators*—Cases.

Europeans.

Centres.

Days late.	Number of wounds.															Total.	Percentage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 and over		
0 ...	28	6	4	4	1	1	...	...	...	1	...	1	...	...	...	...	46	...
1 ...	34	4	8	4	3	...	1	...	...	...	...	...	...	1	...	...	55	...
2 ...	51	2	4	4	3	1	...	...	...	...	1	...	...	...	...	...	66	...
3 ...	29	3	3	1	1	...	1	1	1	...	...	...	...	...	...	...	40	...
4 ...	23	7	7	...	1	...	1	...	...	...	...	...	1	...	...	...	40	...
5	15	3	...	...	1	...	...	...	...	...	...	...	...	...	...	...	19	...
6 ...	4	1	2	1	...	...	...	...	...	...	...	...	...	...	...	...	8	...
7 ...	14	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	18	...
8 to 14 ...	31	2	2	2	2	...	...	...	...	...	...	...	...	...	...	...	39	...
15 to 21 ...	7	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	9	...
22 to 28 ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29 to 35 ...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...
36 to 42 ...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43 to 49 ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
50 and over ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total ...	240	28	35	17	12	2	3	1	1	1	1	1	1	1	...	...	344	...
Percentage death rate.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE VII-b.

Classification according to number of wounds and lateness of arrival.

Numerators = Deaths. *Denominators* = Cases.

Asiatics.

Institute.

Days late.	Number of wounds.															Total.	Percentage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 and over.		
0 ...	1	39	121	63	65	2/40	19	13	1/9	4	1	2	...	...	2	3/379	0·79
1 ...	4	99	213	139	102	54	31	11	7	7	2	4	...	...	...	673	...
2 ...	8	34	60	38	34	14	4	5	...	1	...	1	...	...	...	199	...
3 ...	10	18	31	15	16	5	6	4	...	1	...	...	...	...	...	106	...
4 ...	2	22	40	6	21	7	4	1	1	...	...	...	...	...	...	104	...
5 ...	8	11	1/19	8	10	2	1	1	...	...	...	1	...	...	...	1/61	1·60
6 ...	3	5	14	3	6	6	...	...	1	...	...	1	...	...	...	39	...
7 ...	2	6	11	...	5	1	...	...	...	...	...	...	...	...	...	25	...
8 to 14 ...	10	23	40	8	11	5	2	1	...	1	...	...	...	...	...	101	...
15 to 21 ...	...	10	20	5	6	2	2	1	...	...	...	...	...	...	...	46	...
22 to 28 ...	1	2	4	2	...	...	...	...	...	...	...	...	...	...	...	9	...
29 to 35 ...	...	2	5	3	...	1	...	1	...	...	...	...	...	...	...	12	...
36 to 42 ...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	3	...
43 to 49 ...	...	1	5	...	1	...	...	...	...	...	...	...	...	...	...	7	...
50 and over. ...	...	5	16	...	...	...	...	...	...	...	...	...	...	...	...	21	...
Total ...	49	277	1/602	290	277	2/137	69	38	1/18	14	3	9	...	...	2	4/1785	0·22
Percentage death rate.	...	...	0·1	...	...	1·40	...	...	5·50	...	...	...	...	...	...	...	...

TABLE VII-c.

Classification according to number of wounds and lateness of arrival.

Numerators = Deaths. *Denominators* = Cases.

Asiatics.

Centres.

Days late.	Number of wounds.															Total.	Percentage death rate.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14 15 and over.		
0 ...	25	27	79	38	31	7	7	3	3	1	...	2	1	1	... 2	227	...
1 ...	24	2/146	274	193	2/152	54	41	18	11	1/4	6	2	4	2	2 5	5/938	0·53
2 ...	58	181	1/300	1/161	1/128	1/52	1/43	26	21	10	2	1	1	4	1 1	5/990	0·53
3 ...	40	156	301	188	1/121	55	1/41	27	1/13	8	7	2	5	1	2 4	3/971	0·30
4 ...	29	96	212	117	121	32	29	1/23	10	5	3	2	3	...	... 3	1/685	0·14
5 ...	15	62	1/99	72	45	30	20	9	10	1/4	...	...	...	...	... ...	2/366	0·54
6 ...	11	56	55	42	43	11	14	4	2	1	1	1	1	...	... 1	243	...
7 ...	3	1/34	60	42	24	1/9	5	4	1	...	...	...	...	...	... ...	2/182	1·10
8 to 14 ...	39	98	166	100	1/77	24	1/18	5	10	3	4	3	1	...	1 2	2/551	0·36
15 to 21 ...	9	1/30	1/57	22	15	7	3	1	2	1	1	...	...	...	1 ...	2/152	1·30
22 to 28 ...	5	1	10	2	2	...	1	...	...	...	...	...	...	...	... 1	22	...
29 to 35 ...	...	1/17	14	12	5	3	1	2	...	...	...	...	...	...	... ...	1/54	1·80
36 to 42 ...	...	2	1	...	2	...	...	...	...	...	...	...	...	...	... ...	5	...
43 to 49 ...	...	5	10	2	5	1	2	...	...	...	...	...	...	...	... ...	25	...
50 and over.	2	11	26	8	2	1	1	...	...	...	...	...	...	...	... ...	51	...
Total ...	260	5/922	3/1664	1/999	5/776	2/286	3/226	1/122	1/83	2/37	24	13	16	8	7 19	23/5462	0·42
Percentage death rate.	...	0·54	0·18	0·10	0·64	0·69	1·20	0·61	1·20	5·4	...	...	...	...	... ...	...	...

TABLE VIII.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators = Deaths. *Denominators* = Cases.

Europeans.

Institute.

Deep.	Bare.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
+	+	6	...	9	2	...	...	17	...
+	−	1	...	...	...	...	...	1	...
−	+	2	...	24	...	1	...	27	...
−	−	...	...	...	...	...	...	...	...
Total ...		9	...	33	2	1	...	45	...
Percentage death rate.		...	...	...	...	...	...	...	...

TABLE VIII-a.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators = Deaths. *Denominators* = Cases.

Europeans.

Centres.

Deep.	Bare.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
+	+	9	...	20	...	2	1	32	...
+	−	6	...	5	1	...	...	12	...
−	+	10	2	276	1	4	...	293	...
−	−	4	...	3	...	...	...	7	...
Total ...		29	2	304	2	6	1	344	...
Percentage death rate.		...	...	...	...	...	...	...	...

TABLE VIII-b.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators = Deaths. *Denominators* = Cases.

Asiatics.
Institute.

Deep.	Bare.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
+	+	889	10	2/294	37	1/32	4	3/1266	0·23
+	—	274	16	22	5	...	...	317	...
—	+	36	...	1/89	5	6	...	1/136	0·73
—	—	56	3	7	...	...	...	66	...
Total ...		1,255	29	3/412	47	1/38	4	4/1785	0·22
Percentage death rate.		...	...	0·72	...	2·8	...	...	...

TABLE VIII-c.

Classification according to position and depth of wounds, and interposition of clothing.

Numerators = Deaths. *Denominators* = Cases.

Asiatics.
Centres.

Deep.	Bare.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
+	+	3/1830	66	3/836	4/164	7/178	3/84	20/3158	0·63
+	—	1/559	66	135	16	4	1	1/781	0·13
—	+	552	29	2/518	25	37	11	2/1172	0·17
—	—	263	29	53	5	1	...	351	...
Total ...		4/3204	190	5/1542	4/210	7/220	3/96	23/5462	0·42
Percentage death rate.		0·12	....	0·32	1·90	3·10	3·10	...	...

TABLE IX.

Classification according to position of wounds and lateness of arrival.

Numerators = Deaths. *Denominators* = Cases.

Europeans.

Institute.

Days late.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
0 ...	3	...	3	...	...	...	6	...
1 ...	4	...	10	1	1	...	16	...
2 ...	...	...	5	...	...	...	5	...
3 ...	1	...	2	...	...	...	3	...
4 ...	...	...	3	1	...	...	4	...
5 ...	1	...	6	...	...	...	7	...
6 ...	...	...	1	...	...	...	1	...
7 ...	...	...	1	...	...	...	1	...
8 to 14 ...	...	...	1	...	...	...	1	...
15 to 21 ...	...	...	1	...	...	...	1	...
22 to 28 ...	...	...	...	...	...	...	...	...
29 to 35 ...	...	...	...	...	...	...	...	...
36 to 42 ...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	...	...	...	...	...	...
50 and over ...	...	...	...	...	...	...	...	...
Total ...	9	...	33	2	1	...	45	...
Percentage death rate ...	...	...	...	...	...	...	...	...

TABLE IX-a.

Classification according to position of wounds and lateness of arrival.

Numerators = Deaths. *Denominators* = Cases.

Europeans.

Centres.

Days late.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
0 ...	1	1	38	1	4	1	46	...
1 ...	7	...	48	...	...	...	55	...
2 ...	5	...	60	...	1	...	66	...
3 ...	3	...	36	1	...	...	40	...
4 ...	3	...	36	...	1	...	40	...
5 ...	1	...	18	...	...	...	19	...
6 ...	3	...	5	...	...	...	8	...
7 ...	...	...	18	...	...	...	18	...
8 to 14 ...	4	1	34	...	...	...	39	...
15 to 21 ...	2	...	7	...	...	...	9	...
22 to 28 ...	...	...	...	...	...	...	...	...
29 to 35 ...	...	...	3	...	...	...	3	...
36 to 42 ...	...	...	...	...	...	...	...	...
43 to 49 ...	...	...	1	...	...	...	1	...
50 and over ...	...	...	...	...	...	...	...	...
Total ...	29	2	304	2	6	1	344	...
Percentage death rate ...	...	...	...	...	...	...	...	...

TABLE IX-b.

Classification according to position of wounds and lateness of arrival.

Numerators = Deaths. *Denominators* = Cases.

Asiatics.

Institute.

Days late.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
0 ...	260	6	2/86	15	1/11	1	3/379	0·79
1 ...	499	9	132	18	13	2	673	...
2 ...	129	6	57	4	3	...	199	...
3 ...	72	...	31	1	2	...	106	...
4 ...	77	1	21	4	1	...	104	...
5 ...	31	2	1/26	1	...	1	1/61	1·6
6 ...	24	...	12	1	2	...	39	...
7 ...	15	...	9	1	...	...	25	...
8 to 14 ...	69	2	24	1	5	...	101	...
15 to 21 ...	42	...	4	...	...	...	46	...
22 to 28 ...	5	...	3	...	1	...	9	...
29 to 35 ...	10	...	2	...	...	...	12	...
36 to 42 ...	1	1	1	...	...	...	3	...
43 to 49 ...	5	1	...	1	...	...	7	..
50 and over ...	16	1	4	...	...	...	21	...
Total ...	1,255	29	3/412	47	1/38	4	4/1785	0·22
Percentage death rate ...	...	...	0·72	...	2·8	...	...	...

TABLE IX-c.

Classification according to position of wounds and lateness of arrival.

Numerators = Deaths. *Denominators* = Cases.

Asiatics.

Centres.

Days late.	Leg.	Trunk.	Arm.	Multiple.	Face.	Multiple face.	Total.	Percentage death rate.
0 ...	115	3	78	9	19	3	227	...
1 ...	1/570	29	2/243	38	2/46	12	5/938	0·53
2 ...	528	34	312	2/46	2/40	1/30	5/990	0·53
3 ...	591	33	262	1/41	1/28	1/16	3/971	0·30
4 ...	425	24	177	22	1/25	12	1/685	0·14
5 ...	209	13	1/109	1/18	11	6	2/366	0·54
6 ...	139	11	69	5	13	6	243	...
7 ...	1/112	8	1/44	9	7	2	2/182	1·10
8 to 14 ...	1/334	25	152	12	20	1/8	2/551	0·36
15 to 21 ...	1/92	2	46	5	1/7	...	2/152	1·30
22 to 28 ...	8	...	12	2	...	...	22	...
29 to 35 ...	26	5	1/18	3	2	...	1/54	1·80
36 to 42 ...	4	...	1	...	...	...	5	...
43 to 49 ...	16	1	7	...	1	...	25	...
50 and over ...	35	2	12	...	1	1	51	...
Total ...	4/3204	190	5/1542	4/210	7/220	3/96	23/5462	0·42
Percentage death rate ...	0·12	...	0·32	1·90	3·10	3·10	...	...

TABLE X.

Deaths from hydrophobia amongst persons treated in

Europeans.

Institute.

Serial Number.	Case Number.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and position of wounds.				Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.	
					Kind.	Class.	Leg.	Trunk.	Arm.	Face.	Total.	Deep.	Extensive.	Bare skin.					Type.	Duration in days.
Nil.																				

TABLE X-a.

Deaths from hydrophobia amongst persons treated in

Europeans.

Centres.

Serial Number.	Case Number.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and position of wounds.					Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.	
					Kind.	Class.	Leg.	Trunk.	Arm.	Face.	Total.	Deep.	Extensive.	Bare skin.	Uncauterised.					Type.	Duration in days.
Nil.																					

TABLE X-b.

Deaths from hydrophobia amongst persons treated in

Asiatics.

Institute.

Serial Number.	Case Number.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and position of wounds.					Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.	
					Kind.	Class.	Leg.	Trunk.	Arm.	Face.	Total.	Deep.	Extensive.	Bare skin.	Uncauterised.					Type.	Duration in days.
1	2,346	25	M	8	Dog ...	C	...	...	...	5	5	+	—	+	+	0	4	29	IV-f	7cc. 5 per cent.	14
2	1,297	32	F	4	,, ...	D	...	...	2	...	2	—	—	+	+	5	3	40	II	2cc. 5 per cent.	14
3	506	33	M	21	,, ...	C	...	...	8	...	8	+	—	+	—	0	2	35	IV-e	7cc. 5 per cent.	14
4	1,554	50	M	4	,, ...	D	...	...	5	...	5	+	—	+	+	0	5	55	IV-e	5cc. 5 per cent.	14

TABLE

Deaths from hydrophobia

Asia

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Serial Number.	Case Number.	Number of days from commencement of treatment to onset of symptoms.	Sex.	Age in years.	Biting animal.		Number and position of wounds.				
					Kind.	Class.	Leg.	Trunk.	Arm.	Face.	Total.
										Died du	*ring*
1	168	3	M	10	Dog ...	C	1	...	...	2	3
2	383	8	M	5	Wolf ...	C	...	...	...	2	2
3	60	12	M	6	Dog ...	C	...	...	...	3	3
							Died	*with in 15*		*days*	*after*
1	83	15	M	6	Dog ...	C	2	...	...	...	2
2	354	15	M	7	Do. ...	C	...	2	4	...	6
3	161	16	M	7	Jackal ...	C	...	...	2	4	6
4	494	17	M	7	Dog ...	C	...	...	...	3	3
5	62	18	M	5	*Do.* ...	B	...	...	...	1	1
6	338	19	F	35	Jackal ..	C	...	...	...	2	2
7	416	20	M	15	Do.	C	...	...	1	...	1
8	60	23	M	9	Dog ...	C	...	...	...	1	1
							Died	*aft er 15*		*days*	*after*
1	113	30	F	38	Dog ...	C	1	...	5	...	6
2	55	30	M	65	Do. ...	C	5	...	4	...	9
3	134	34	M	5	Do. ...	C	...	2	...	3	5
4	57	41	M	60	Do. ...	C	4	...	...	...	4
5	143	43	M	35	Jackal ..	C	...	...	4	4	8
6	155	48	M	20	Dog ...	C	...	...	2	...	2
7	16	53	F	60	Do. ..	C	...	...	...	4	4
8	87	75	M	60	Jackal ...	D	...	...	...	1	1
9	7	76	M	10	Dog ...	D	...	...	4	...	4
10	95	90	M	35	Do. ...	D	...	...	1	...	1
11	196	97	M	9	Do. ...	D	5	...	...	...	5
12	137	123	M	6	Do. ...	C	...	...	...	7	7
13	105	129	M	13	Do. ...	C	...	1	2	...	3
14	414	155	M	18	Do. ...	C	9	...	...	...	9
15	222	185	M	7	Do. ...	C	...	...	4	...	4

X.c.

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Wounds.				Number of days late.	Duration of illness in days.	Interval between bite and death in days.	Class of cases.	Treatment.	
Deep.	Extensive.	Bare skin.	Uncauterised.					Type.	Duration in days.
treat ment.									
+	−	+	+	8	1	12	IV-f	5 cc. 5 per cent. ...	2
+	−	+	+	15	2	25	IV-f	7 cc. 5 per cent. ...	9
+	−	+	+	15	3	30	IV-f	Do. ..	12
comp letion of tr eat m ent.									
+	−	+	+	15	1	31	III	5 cc. 5 per cent. ...	14
+	−	+	+	2	1	18	IV-e	Do. ...	14
+	−	+	+	11	2	29	IV-f	7 cc. ...	14
+	+	+	+	2	5	24	IV-f	Do. ...	14
+	−	+	+	10	1	35	IV-f	Do. ...	14
+	−	+	+	2	2	23	IV-f	10 cc. ...	14
+	−	+	+	30	1	51	IV-e	7 cc. ...	14
+	+	+	−	1	4	28	IV-f	Do. ...	14
comp letion of tr ea t m ent.									
+	−	+	+	3	3	36	III	5 cc. 5 per cent. ...	14
+	−	+	+	5	3	38	IV-e	7 cc. ...	14
+	−	+	+	2	4	40	IV-f	Do. ...	14
+	−	−	−	8	3	52	III	5 cc. ...	14
+	−	+	+	3	2	48	IV-f	10 cc. ...	14
−	−	+	−	5	4	57	III	5 cc. ...	14
+	−	+	+	3	2	58	IV-f	10 cc. ...	14
+	−	+	+	1	3	78	IV-f	Do. ...	14
−	−	+	+	1	2	79	II	2 cc. ...	14
−	−	+	+	7	3	100	II	Do. ...	14
+	−	+	−	7	1	105	III	5 cc. ...	14
+	+	+	+	4	3	130	IV-f	7 cc. ...	14
+	−	+	+	2	1	132	III	5 cc. ...	14
+	−	+	+	1	3	159	III	Do. ...	14
+	−	+	+	1	3	189	III	Do. ...	14

TABLE XI.

Classification of the animal which bit, scratched or licked the patient.

Numerators = Deaths. *Denominators* = Cases.

Animal.	Institute.									Centres.								
	Number treated.			Percentage to total.			Death rate per cent.			Number treated.			Percentage to total.			Death rate per cent.		
	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.	Europeans.	Asiatics.	Combined.
Dog	44	4/1712	4/1756	...	95·9	95 9	...	0·23	0·22	326	18/4740	18/5066	94·70	86 80	87·20	...	0 38	0·35
Jackal	...	21	21	...	1·1	1·1	...	...	...	...	5/635	5/635	...	11·60	10·90	...	0·78	0·78
Cat	...	25	25	...	1·4	1·3	...	...	...	1	18	19	0·20	0·30	0·30	...	...	
Monkey	1	14	15	...	0·7	0·8	...	...	...	3	11	14	0·80	0·20	0·20	...	...	...
Fox	...	3	3	...	0·1	0·1	...	...	...	...	3	3	...	0·05	0·05	...	...	...
Human beings ..	...	5	5	...	0·2	0·2	...	...	...	13	23	36	3·70	0·40	0·60	...	...	...
Donkey	...	2	2	...	0·1	0·1	...	...	...	...	8	8	...	0·10	0·10	...	...	...
Horse	...	2	2	...	0·1	0·1	...	...	...	1	16	17	0·2	0·30	0·20	...	...	...
Calf	...	1	1	...	...	...	...	...	...	...	3	3	...	0·50	0·50	...	...	...
Mongoose	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...
Wolf	...	...	...	...	...	...	...	...	...	...	3	3	...	0·50	0·50	...	...	...
Bear	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...
Total ...	45	4/1785	4/1830	...	...	...	...	...	...	344	23/5462	23/5806	...	...	...	...	...	...

TABLE XII.

Number of patients treated by months.

	Institute.			Centres.			Institute and Centres combined.		
	Europeans.	Asiatics.	Total.	Europeans.	Asiatics.	Total.	Europeans.	Asiatics.	Total.
January	3	130	133	27	424	451	30	554	584
February	1	130	131	33	441	474	34	571	605
March	5	164	169	21	499	520	26	663	689
April	2	176	178	43	486	529	45	662	707
May	2	159	161	23	504	527	25	663	688
June	3	164	167	34	468	502	37	632	669
July	1	149	150	12	443	455	13	592	605
August	3	155	158	59	395	454	62	550	612
September	10	164	174	22	425	447	32	589	621
October	5	132	137	22	489	511	27	621	648
November	3	93	96	14	439	453	17	532	549
December	7	169	176	34	449	483	41	618	659
Total ...	45	1,785	1,830	344	5,462	5,806	389	7,247	7,636

TABLE XIII.

Statement showing brains submitted and examined for rabies.

Serial number.	Animal.	Number of brains examined.	Positive.	Negative.	Unfit for examination.
1	Dogs	170	131	35	4
2	Cats	3	2	1	.....
3	Cows	3	.....	3	.....
4	Goats	1	1	.....	.....
5	Donkey	1	.....	1	.....
6	Jackal	1	1	.....	.....
7	Monkey	1	.....	1	.....
8	Human being	1	1	.....	.....
	Total ...	181	136	41	4

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